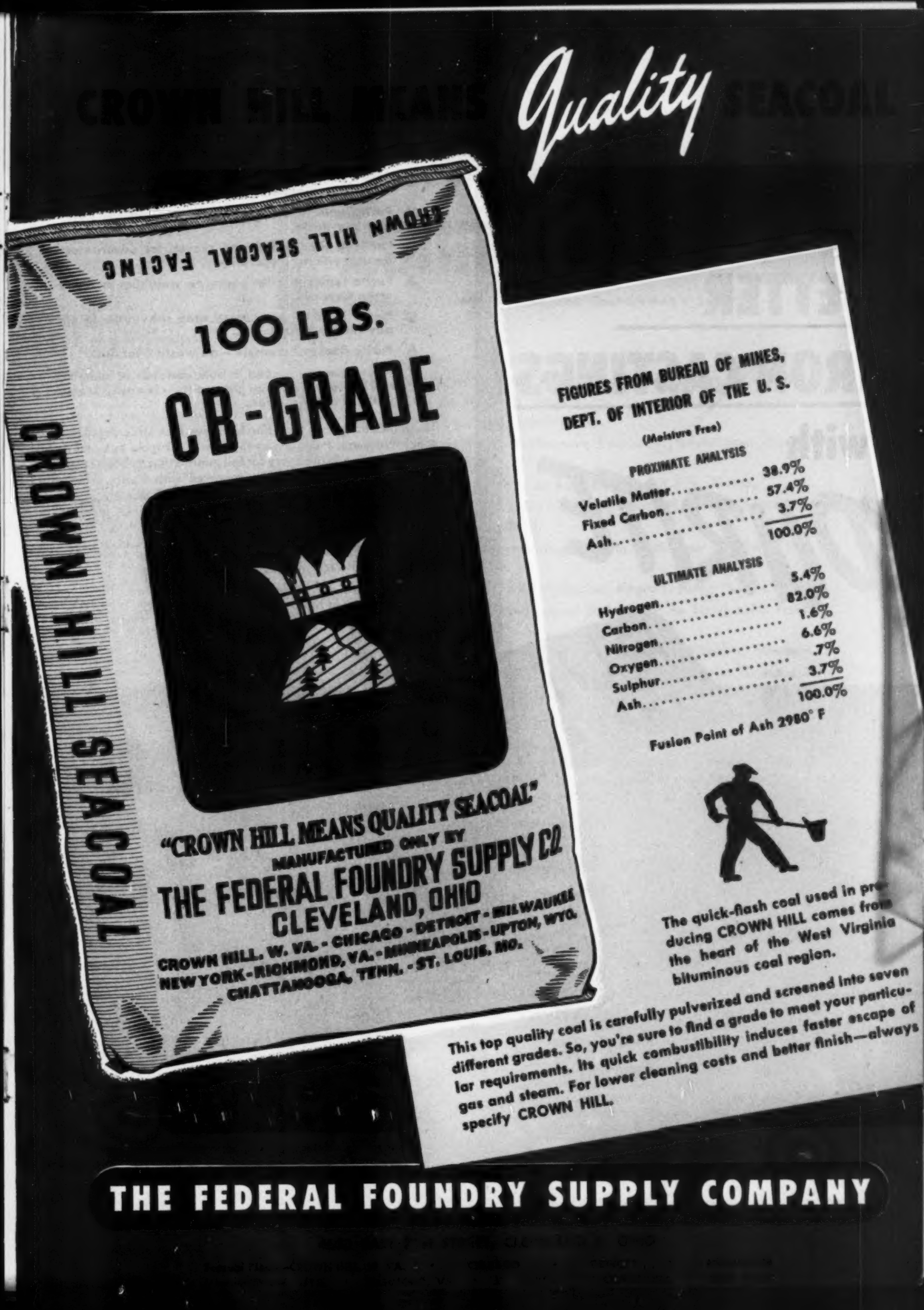
American

THE FOUNDRYMEN'S OWN MAGAZINE

Aug. 1951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CROWN HILL SEACOAL FACING
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The quick-flash coal used in producing CROWN HILL comes from the heart of the West Virginia bituminous coal region.
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A.F.S. HEADQUARTERS
616 S. MICHIGAN AVE.
CHICAGO 5, ILL.

VOLUME XX, NUMBER 2

American Foundryman

August, 1951

Official publication of American Foundrymen's Society

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Setting and checking cores for cylinder blocks and transmission cases on a mold production line at Caterpillar Tractor Co., Peoria, Ill. Mold transfer cars are moved hydraulically. Cooling tunnel for pouring line at right is heavily reinforced to permit flask storage in what might otherwise be waste space. Area is serviced by two large overhead cranes, a gantry crane, and a hoist, the latter for pouring.

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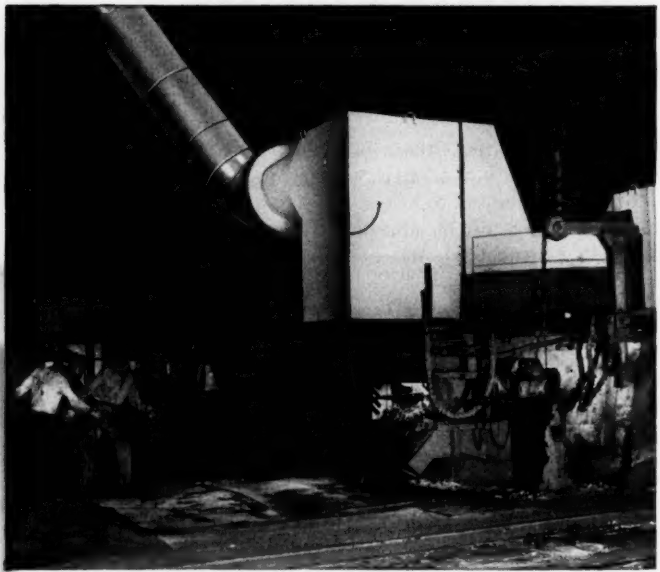
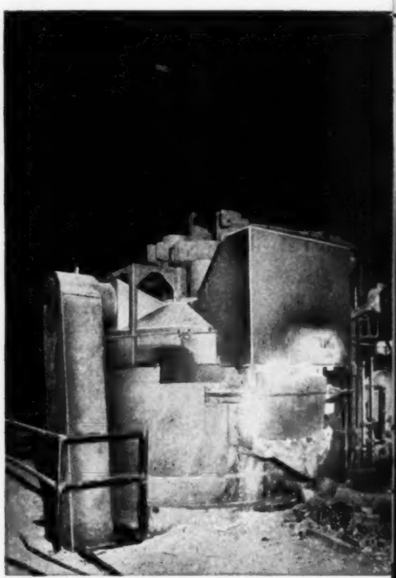
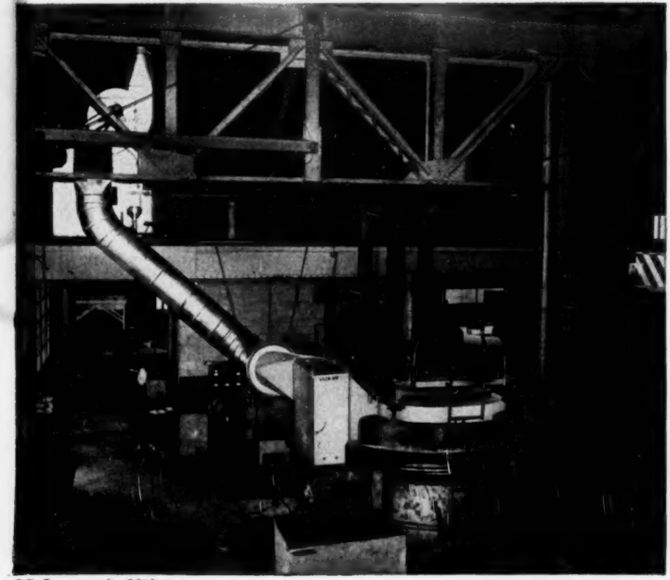
winter foundry strategy calls



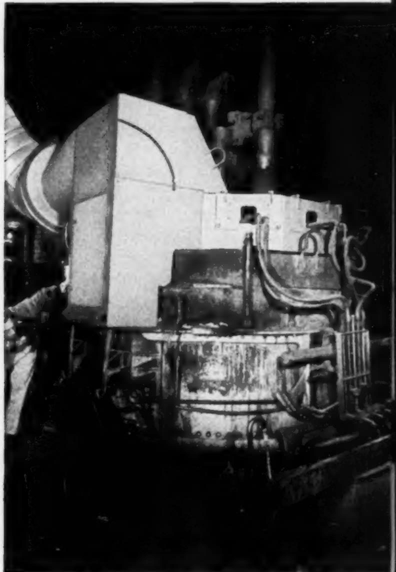
12 Ton Heroult, Side Charge, Baltimore



PT Lectromelt, Chicago

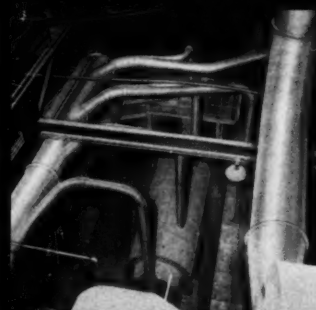


OT Lectromelt, Midwest



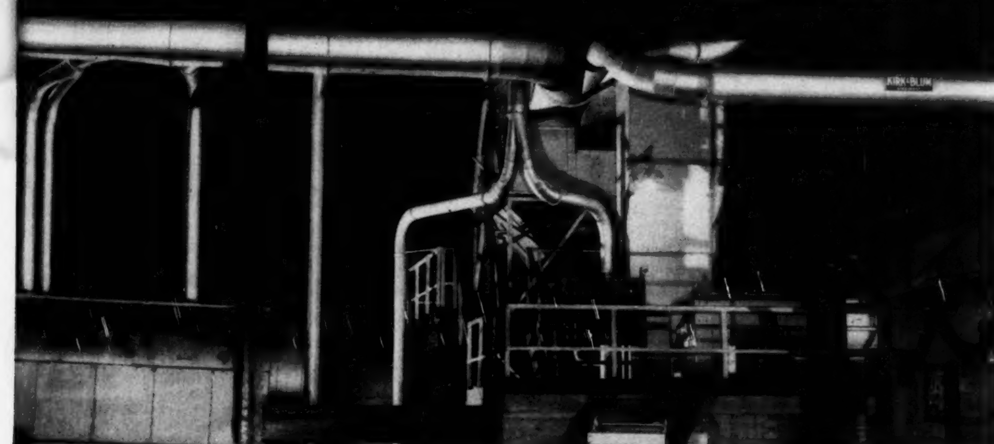
Q Lectromelt, Missouri

Dust Control connections to Simpson Mixers in right foreground.

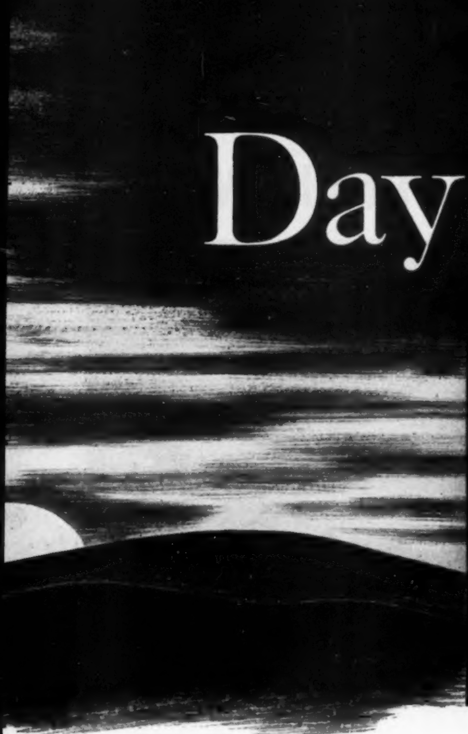


Kirk & Blum Dust Control on a Rotary Breaker Screen.

View of sand handling equipment with rotary breaker screen on the left.



Day or Night



Stevens Service stands ready to help you with your Foundry Problems

Foundrymen all over the nation will attest that Stevens service extends all the way down the line – from the initial sale of a product through to guaranteed satisfaction with the results. As one of Stevens customers put it in his own words – "The Stevens organization gives top-notch service. You can call on the Stevens people at any hour, day or night, and get immediate action on foundry problems."

This same opinion is widely shared in the foundry industry. For over fifty years Frederic B. Stevens, Inc., have made prompt action their creed. From the first beginnings, Stevens has stood ready at all times to render service to foundrymen. Orders are handled with dispatch. Products are guaranteed to meet representation. Technical assistance in selecting the right product to meet specific requirements is extended to our customers. And Stevens Research, Development and Control program is at your service constantly to help you achieve better casting results at lower cost. If you have a problem in foundry operation, Stevens can give you the right answer. So call in your nearby Stevens representative or write direct to *Frederic B. Stevens, Inc., Detroit 16, Michigan.* We welcome your inquiries and there's no obligation.

EVERYTHING FOR A FOUNDRY

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ALLOYS

FROM AJAX-NORTHRUP FURNACES

Because it stirs as it melts, the Ajax-Northrup induction melting furnace thoroughly mixes all constituents—light or heavy. You can depend on absolute uniformity and homogeneity in every heat.

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High speed also means no time for oxidation, no loss of expensive constituents. Of its close control, one user says "once you get the technique worked out, even the toughest melting problems are reduced to routine." Comfortable, too, because all the heat is generated right in the melt by induction.

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You'll find Ajax-Northrup furnaces ideal for all your close-analysis melting. Ideal also for many *heating* jobs in your plant. Just tell us what you want to do; we'll dig into our 34 years of experience and show you how.

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AJAX NORTHRUP

HEATING & MELTING

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Advertisement

ELECTROMET *Data Sheet*

A Digest of the Production, Properties, and Uses of Steels and Other Metals

Published by Electro Metallurgical Company, a Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y. • In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

How VANADIUM improves engineering steels and helps conserve critical alloys

In these critical times when many alloying materials are scarce, you may be able to use vanadium to good advantage. Steels alloyed with vanadium meet most of the mechanical specifications for low-alloy engineering and structural steels. In fact, vanadium can often be used in engineering steels to replace at least part, if not all, of certain alloys now in critical supply.

The metallurgy of vanadium is well known. Small additions of vanadium—0.10 to 0.30 per cent—can be used effectively to give steel extra strength, toughness, and resistance to fatigue and wear. It improves engineering steels by increasing their yield strength without sacrificing ductility. The uniformly fine grain size of vanadium-bearing steels makes them tough and resistant to abrasion, fatigue, and impact.

Better Mechanical Properties

In the following table are typical analyses for carbon-vanadium and chromium-vanadium steels that are suitable for most applications where low-alloy, high-strength steels are required. The carbon-vanadium steel is compared with plain-carbon steel; and the chromium-vanadium steel, with chromium-molybdenum steel. Note the excellent properties of the vanadium-bearing steels.

Fig. 1 — Vanadium increases the strength, toughness, and wear resistance of engineering steels for many machine parts, such as this large crankshaft.

Properties of Vanadium Steels Compared With Other Engineering Steels

Typical Analysis, %	Carbon Steel	Carbon-Vanadium Steel	Chromium-Molybdenum Steel	Chromium-Vanadium Steel
Vanadium	—	0.16	—	0.16
Carbon	0.50	0.49	0.50	0.50
Manganese	0.71	0.77	0.80	0.79
Silicon	0.19	0.15	0.30	0.31
Chromium	—	—	0.95	0.98
Molybdenum	—	—	0.20	—
Annealed and Furnace-Cooled				
Tensile Strength, psi	90,600	100,000	100,000	99,500
Yield Point, psi	48,900	66,000	50,000	64,100
Elongation in 2 in., %	23.3	25.0	23.0	28.4
Reduction of Area, %	37.8	49.1	45.0	59.0
Izod Impact, ft.-lb.	13.5	26.0	17.0	44.0
Quenched and Tempered				
Tensile Strength, psi	134,900	134,500	232,000	232,800
Yield Point, psi	110,800	128,000	214,500	224,200
Elongation in 2 in., %	18.3	18.3	10.0	10.4
Reduction of Area, %	54.1	56.6	39.0	43.1
Izod Impact, ft.-lb.	54.0	65.0	12.0	12.0

Improves Cast Iron

A small addition of vanadium, usually from 0.10 to 0.25 per cent, refines the grain of cast iron, and materially increases its strength and hardness. Moreover, vanadium may be used in cast iron to replace at least part, if not all, of certain alloys that are now in short supply.

Vanadium in Rimmed Steel

An addition of approximately 1 lb. of vanadium per ton of steel produces non-aging characteristics in a rimmed steel. These non-aging properties, together with improved deep-drawing characteristics and the good surface inherent in rimmed steels, make these steels of particular interest at the present time.

Grades of Ferrovanadium

ELECTROMET produces ferrovanadium containing 50 to 55 per cent vanadium for the production of vanadium-bearing steels and irons. The alloy is produced in three grades with maximum 0.20, 0.50, or 3.00 per cent carbon and maximum 1.50, 2.00, and 8.00 per cent silicon, respectively. Each grade is specially adapted to fill the different requirements of iron- and steel-making.

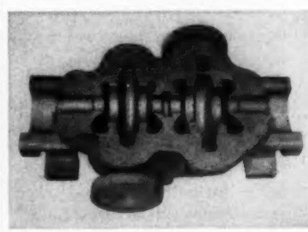


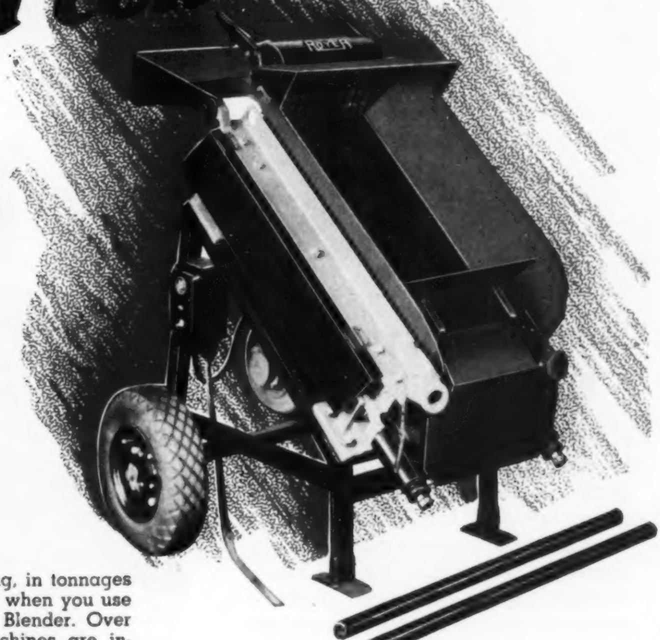
Fig. 2—Steel and iron castings treated with small additions of vanadium have high ductility and greater toughness and impact resistance.

Write for a copy of the booklet, "ELECTROMET Ferro-Alloys and Metals," which gives helpful information about the use of ferrovanadium and other alloying metals that ELECTROMET supplies. The booklet may be obtained from any ELECTROMET office: in Birmingham, Chicago, Cleveland, Detroit, Los Angeles, New York, Pittsburgh, or San Francisco. In Canada: Welland, Ontario.

fast, efficient sand conditioning

with a Royer

Available in sizes to meet any capacity requirement



Fast, efficient sand conditioning, in tonnages to meet your needs, is assured when you use a Royer Sand Separator and Blender. Over 8000 of these cost-cutting machines are installed in foundries all over the world . . . producing properly prepared molding sand for jobbing and production shops. More than 50% of the Royer users have ordered additional machines—concrete evidence of their efficient performance.

Sand is shovelled into the low hopper of the Royer and the automatic action of the machine completes the job. The conditioned sand when discharged is thoroughly blended, mixed and aerated, with all refuse removed . . . ready for the molder's use.

In addition to the savings made in direct labor costs of sand conditioning, this properly prepared sand will produce smoother, better castings with fewer rejects. Cleaning and grinding time is materially reduced . . . with a consequent increase in profits to you.

Regardless of your needs — proper, efficient sand conditioning is available with a Royer. Write for complete details.

Illustrated is the Model NC-2 with a capacity of 12 to 15 tons of sand per hour. The table below lists the models available, with capacities, motor sizes and weights.

Model	Tons Capacity per hour	Electric Motor	Net Weight Lbs.
Junior	4 to 7	½ HP	270
NB-2	7 to 9½	¾ HP	465
NB-4	7 to 9½	¾ HP	510
NC-2	12 to 15	1½ HP	660
NC-4	12 to 15	1½ HP	730
NDP	20 to 25	2 HP	1265
NDS	20 to 25	2 HP	1070
NRS	40 to 50	5 HP	1375
D Special	20 to 25	......	700
R Special	40 to 50	......	900

FOREMOST IN SAND CONDITIONING EQUIPMENT

ROYER FOUNDRY & MACHINE CO.
155 PRINGLE ST., KINGSTON, PA.

MEXICAN CORDIP® — ANOTHER NEW PRODUCT DEVELOPED BY THE UNITED STATES GRAPHITE COMPANY

NEW NON-FERMENTING WASH GIVES SMOOTHER, TRUER CASTINGS

Mexican Cordip is just one of the many new products that are continually being developed by the research facilities of The United States Graphite Company. Mexican Cordip is a high temperature coating that gives castings maximum surface smoothness. Dry or green cores maintain true dimensions because Mexican Cordip *will not build up or run on core surfaces.* It penetrates sand to an effective depth to prevent burn-in. Since its development in the laboratories, Mexican Cordip has proven its worth in daily use in some of America's finest foundries. Mexican Cordip is supplied in powdered form complete with binder and is *easy to prepare and use* either as a spray or dip. Also, Mexican Cordip is non-fermenting. There's no messy dip tank cleaning . . . no disagreeable odors.

1⅛" cores with small cylindrical cavity being charged with metal (left) for insertion into the hot zone of the Dilatometer (right). Metal melts to form a small pellet. After cooling, the core and casting are studied for ease of removal, coating remaining, burn-in, and surface appearance.

Small cupola used to simulate actual pouring conditions at The United States Graphite Company laboratory.

MODERN LABORATORY DUPLICATES ACTUAL FOUNDRY CONDITIONS FOR BETTER PRODUCT RESEARCH

Old-time foundry men and newly graduated metallurgists alike who have visited The United States Graphite Company's neat, new foundry research laboratories in Saginaw have been enthusiastic about the completeness of the equipment, *the thoroughness of the tests*—and the extent to which the engineers here are going in order to develop even better Mexican Graphite products for America's foundries.

In this amazingly complete laboratory is a perfect little 4½" diameter cupola that exactly duplicates the results of its big brothers on production. An electric furnace and a Dilatometer are used to study the effect of temperatures up to 3000° F under just about any atmosphere. Metallurgical microscopes are used for closer study (up to 3,000 diameters) of the sand-metal interface of experimental cores and molds.

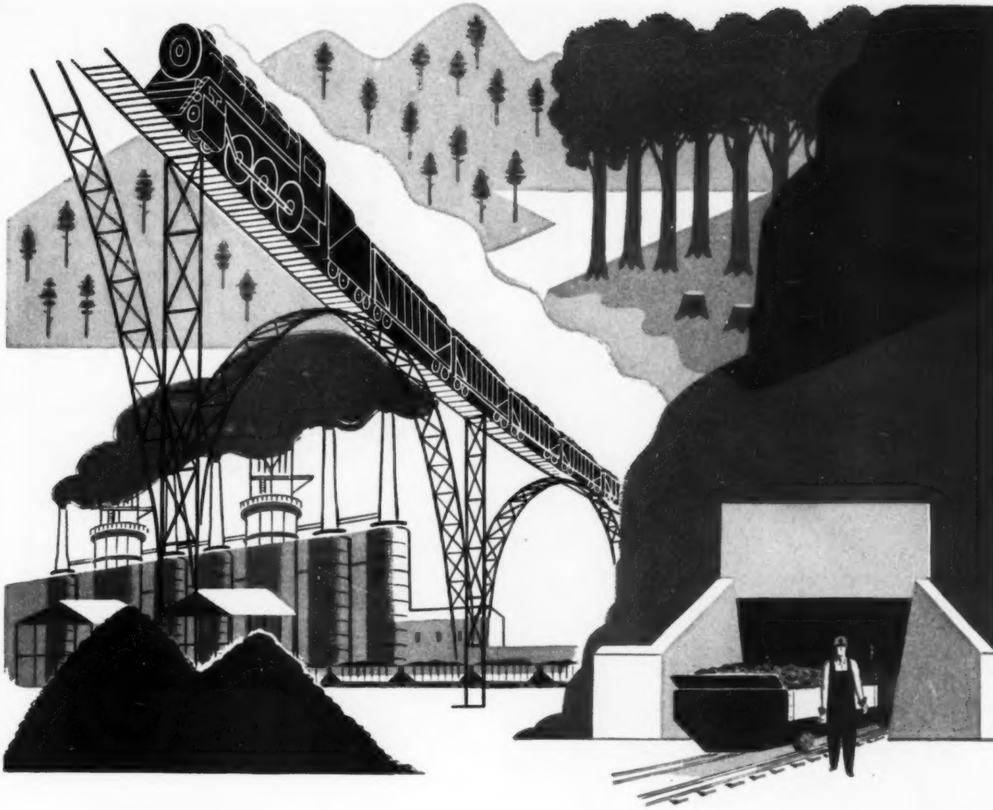
There is a core oven and complete sand testing equipment so that precise studies can be made of the penetration, effect on surface, and physical characteristic of sand when using various types of Mexican Graphite washes.

Within this modern laboratory there is even a chemical laboratory *fully equipped for making every kind of test and analysis* that is likely to apply to foundry products and foundry practice.

It is largely because of the completeness of this modern laboratory—and the skill, knowledge and creative ability of the engineers here that United States Graphite Company products are so effectively saving production time, cutting costs and helping to assure better castings in America's leading foundries today. *This laboratory is at your service.* Call or write us.

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN



INTRICATE LARGE CASTINGS ...readily produced in DUCTILE IRON

DUCTILE IRON is a cast ferrous product that combines the *process advantages* of cast iron with many of the *product advantages* of cast steel.

In less than two years, ductile iron has attained wide acceptance because it offers excellent castability, high mechanical properties, and good machinability. Parts cast in ductile iron show superior pressure tightness, high modulus and resistance to shock.

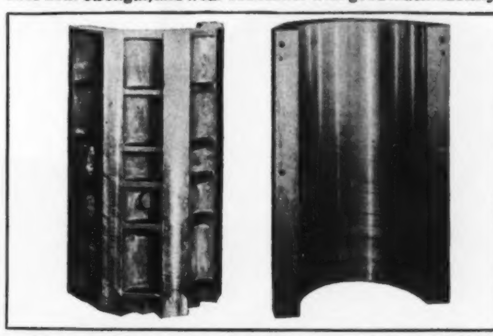
Typical current applications include chemical pots, compressor shells, cylinders for hydraulic presses, fly wheels, housing for electric power driven tools, large gears for coal mine equipment, vise jaws, and many other parts.

AVAILABILITY

Send us details of your prospective uses, so that we may suggest a source of supply from some 100 authorized foundries now producing ductile iron under patent licenses. Request a list of available publications on ductile iron...mail the coupon now.

ST. PAUL FOUNDRY & MANUFACTURING CO., St. Paul 3, Minn., cast this hydraulic head for a billet conditioner in ductile iron having 92,000 p.s.i. tensile strength, 67,000 p.s.i. yield point and 7.8% elongation.

STAVER FOUNDRY COMPANY, Virginia, Minn., produced this large hoist drum in ductile iron to meet requirements of toughness with strength, and wear resistance with good machinability.



PYOTT FOUNDRY & MACHINE CO., Chicago 7, Ill., produced these ductile iron castings for dies for forming 24″ to 36″ diameter pipe from steel plate of ¼″ to ½″ thicknesses. The finished tooling was done by the Vernon Allsteel Press Co. of Chicago. The dies are to be used in large presses that exert 18,000 tons pressure.

EMBLEM OF INCO SERVICE

The International Nickel Company, Inc.
Dept. AF., 67 Wall Street, New York 5, N. Y.
Please send me a list of publications on: **DUCTILE IRON**

Name...Title.....................
Company...
Address...
City...State.....................

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.

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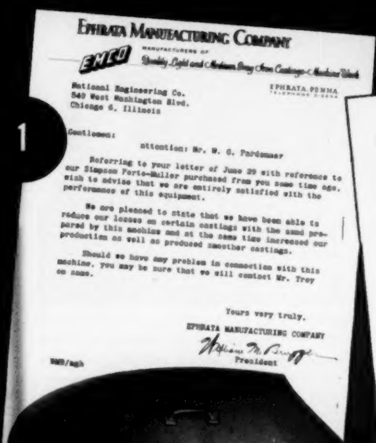
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EPHRATA MANUFACTURING COMPANY

EMCO MANUFACTURERS OF Quality Light and Medium Gray Iron Castings · Machine Work

EPHRATA, PENNA.

National Engineering Co.
549 West Washington Blvd.
Chicago 6, Illinois

Gentlemen:

Attention: Mr. W. G. Pardonner

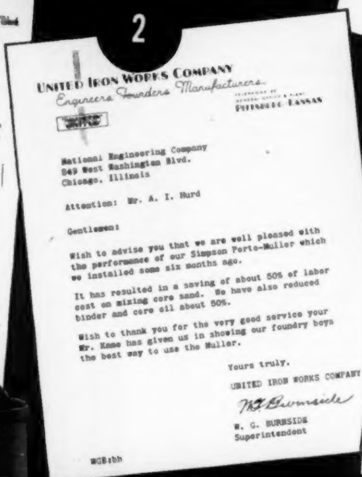
Referring to your letter of June 29 with reference to our Simpson Porto-Muller purchased from you some time ago, wish to advise that we are entirely satisfied with the performance of this equipment.

We are pleased to state that we have been able to reduce our losses on certain castings with the sand prepared by this machine and at the same time increased our production as well as produced smoother castings.

Should we have any problem in connection with this machine, you may be sure that we will contact Mr. Troy on same.

Yours very truly,
EPHRATA MANUFACTURING COMPANY
William M. Bruggs
President

WMB/mgh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UNITED IRON WORKS COMPANY
Engineers Founders Manufacturers

PITTSBURG, KANSAS

National Engineering Company
549 West Washington Blvd.
Chicago, Illinois

Attention: Mr. A. I. Hurd

Gentlemen:

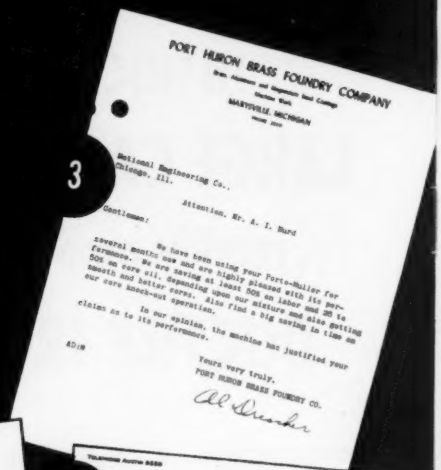
Wish to advise you that we are well pleased with the performance of our Simpson Porto-Muller which we installed some six months ago.

It has resulted in a saving of about 50% of labor cost on mixing core sand. We have also reduced binder and core oil about 50%.

Wish to thank you for the very good service your Mr. Kane has given us in showing our foundry boys the best way to use the Muller.

Yours truly,
UNITED IRON WORKS COMPANY
W. G. Burnside
W. G. BURNSIDE
Superintendent

WGB:bb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PORT HURON BRASS FOUNDRY COMPANY

MARYSVILLE, MICHIGAN

National Engineering Co.,
Chicago, Ill.

Attention, Mr. A. I. Hurd

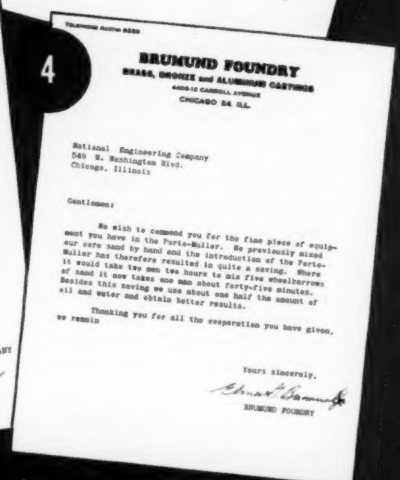
Gentlemen:

We have been using your Porto-Muller for several months now and are highly pleased with its performance. We are saving at least 50% on labor and 25 to 50% on core oil, depending upon our mixture and also getting smooth and better cores. Also find a big saving in time on our core knock-out operation.

In our opinion, the machine has justified your claims as to its performance.

AD:W

Yours very truly,
PORT HURON BRASS FOUNDRY CO.
Al Drescher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BRUMUND FOUNDRY
BRASS, BRONZE and ALUMINUM CASTINGS
CHICAGO 24 ILL.

National Engineering Company
549 W. Washington Blvd.
Chicago, Illinois

Gentlemen:

We wish to commend you for the fine piece of equipment you have in the Porto-Muller. We previously mixed our core sand by hand and the introduction of the Porto-Muller has therefore resulted in quite a saving. Where it would take two men two hours to mix five wheelbarrows of sand it now takes one man about forty-five minutes. Besides this saving we use about one half the amount of oil and water and obtain better results.

Thanking you for all the cooperation you have given, we remain

Yours sincerely,
BRUMUND FOUNDRY

READ what experienced foundrymen write about Simpson *Porto-Mullers*—how one *"has saved 50% of labor cost on mixing core sand"*—how another is *"able to reduce losses on certain castings"*—and another *"reduced amount of core oil and binder about 50%."* Apply these actual production experiences to your own operation and see how easily costs can be reduced.

The *Porto-Muller* is completely self-contained and portable. The 300 lb. capacity mixer with spring-adjusted mullers, and the 3 H.P. motor are compactly mounted on pneumatic tires for easier handling. Simply roll up to the sand pile—load—start mulling. *Write for Bulletin 492.*

NATIONAL *Engineering Company*
600 Machinery Hall Bldg. • Chicago 6, Illinois

SIMPSON *Intensive* MULLERS

A Metal Conservation Bibliography compiled by *American Foundryman* from material published by the American Foundrymen's Society may be obtained gratis on request. Listed in the bibliography are sources for details of techniques as brought out below in this month's editorial.

HOW TO BEAT METAL SHORTAGES

MELTING STOCK shortages, which have been with the foundry industry so long we should be accustomed to them, today are aggravated by rising production demands and government controls.

With the likelihood that more pig and ingot will not become available for some considerable time, the foundryman must look to scrap for a bigger proportion of his metal. The scrap situation is hardly brighter than other metallics which leads us to several possible solutions.

We can reduce the total metal requirement of the foundry industry by increasing casting yield . . . reduce losses through improved melting and pouring . . . and secure more scrap.

Improved casting yield will decrease the unproductive metal melted, thus reducing the total amount needed in circulation to produce a given tonnage of castings. Collateral advantages include lower cost for fuel or power for melting, and reduced refractory consumption.

Factors that increase riser efficiency or promote directional solidification will increase yield. Round rather than square risers are more practical since cooling at the corners of the latter soon decreases their effectiveness to that of round risers with the diameter of a circle inscribed in the square.

Careless pouring which allows more metal to be poured than is necessary to feed a casting decreases yield. The fin of metal formed when a riser overflows onto the cope is an efficient radiator which seriously reduces riser effectiveness by making it freeze over faster. Some foundrymen have controlled pouring and metal level in risers by means of an alarm given when metal closed an electrical contact as it rose in the riser to the proper level.

Riser sizes can be reduced through use of collars of insulating materials such as perlite or diatomaceous earth for the high or low melting point metals, special plaster compositions for the low melting alloys. Riser collars can be made of exothermic materials which add heat to the riser. The same types of materials sprinkled on the risers are much more effective than a scoop of sand or floor sweepings, or an insulating material, in promoting riser fluidity.

In metals which form a skin rapidly after pouring, notably steel, riser sizes have been reduced by using atmospheric risers—with or without exothermic or gas-forming cores.

Directional solidification with attendant reduction in risering and padding can be promoted by means of appropriate use of insulating materials in the mold where solidification is too fast. And by chills, chill nails, zircon sand mixtures, and chill-promoting mold and core washes for sections that do not cool fast enough.

Melting losses automatically will be cut down if yield is increased. But even without higher yields, some small reductions in melting loss can be effected through more accurate melting control and use of minimum oxidizing conditions required for the melting being performed.

All the techniques suggested above, assuming they are applied diligently and universally, will not conserve so much metal that the foundry industry can relax its search for scrap and discontinue its hope that more pig and ingot metal will someday be available.

All dormant scrap should be sought out in the foundries and used by the shops which have it, or fed into customary channels. Such scrap may be found in obsolete equipment, in slag dumps, in wholly unexpected quarters. We've heard of one shop that turned up a large, hidden source of scrap in pouring spills during conversion from the old-fashioned sand floor to a modern concrete floor!

Another source of scrap some foundrymen may be overlooking is borings and turnings which can be briquetted for convenience in handling and efficiency in melting.

Melting stock shortages can be serious but we're banking on the ingenuity of foundrymen to pull the industry through by taking advantage of available information, developing new techniques, and ferreting out existing scrap. *—Editor.*

CASTING SURFACE : VOLUME RATIO PREDICTS GRAY IRON PROPERTIES

F. W. Kellam, Met.
and
H. H. Fairfield, Chief Met.
Wm. Kennedy & Sons Ltd.
Owen Sound, Ont., Canada

A simple reference chart—which each foundry must work out for its own irons—from which strength, hardness, and machinability can be predicted for each grade of gray iron, cast in any section thickness, was plotted from data obtained by pouring step blocks in the various irons. The properties of the iron are classified on the basis of the surface to volume ratio rather than on the section thickness of the casting. The chart includes machinability of the irons, and is a useful tool for the plant metallurgists, designing engineers, and the foundry cost estimators.

The A.S.T.M. Classification of Gray Cast Irons Classes 20 to 60 designates the tensile strength of these various irons when cast in test bars conforming to the section thickness of the casting. Unlike steel, the strength of gray iron depends on the section thickness or surface to volume ratio of the casting. That is, iron poured into a 1-in. section will be stronger than the same iron poured into a 2-in. section.

In the jobbing foundry the application of this principle becomes very important since the range of section thicknesses is quite wide and very often the customer designates the required strength in a certain section of a casting. The principle is also applicable in production foundries where machinability is of prime importance since an increase in strength generally means an increase in hardness.

In the foundry in which the writers are employed the designation of the iron used depended upon the skill and memory of the metallurgist in applying this principle. Present-day demands for castings made to specification and design strengths, pressure, tightness and machinability requirements necessitated a more rigid control of this application.

Some method had to be found to determine what strength the irons made in this foundry gave when poured into various sections. Geist and Hambly[2] described a practical method of selecting the proper grade of iron, but it was felt that a more ready and simpler reference chart was needed for the personnel involved. A study of the literature on properties of gray iron [3, 4, 5, 6, 7, 8] indicated that the irons made in the authors' foundry were typical of the gray iron casting industry.

Note: This paper was presented at a recent meeting of the A.F.S. Ontario Chapter.

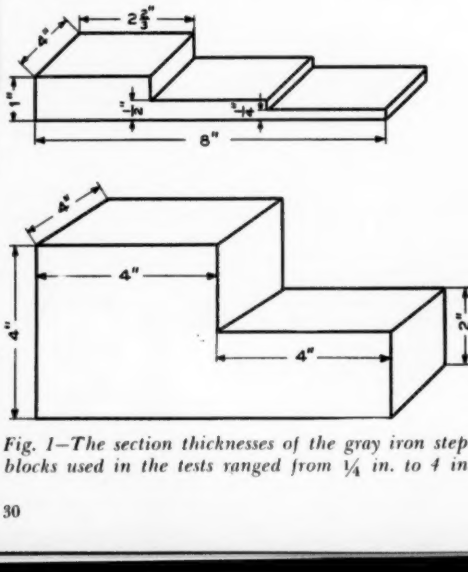


Fig. 1—The section thicknesses of the gray iron step-blocks used in the tests ranged from ¼ in. to 4 in.

The need was for a chart which combined predicted strength, hardness and machinability for each of our grades of iron when cast in any section. The data were obtained by pouring several step-blocks from each grade of iron, taking care that pouring and cooling conditions were constant for each block.

The step-blocks (Fig. 1) had section thicknesses of ¼-in. up to 4 in., but, rather than classify the properties of the iron on the basis of these thicknesses, it was felt that a surface to volume ratio was a better indication of the cooling rate, especially in the use of complicated or continuous shapes. The surface to volume ratio of each of these steps was calculated as follows:

Section Thickness, in.	Surface Area, sq. in., per Volume, cu. in.
4	1.4
3	1.7
1	3.0
½	4.7
¼	8.8

Sample calculation for the 4-in. section:
Total area=$4\times4\times4+4\times4\times2-4\times2=88$ sq. in.
Total volume=$4\times4\times4=64$ cu. in.

$$\frac{\text{Surface}}{\text{Volume}}=\frac{88}{64}=1.37$$

The Brinell hardnesses obtained on the steps of each block were plotted against surface/volume ratios and produced the chart shown as Fig. 2. The various symbols, designating the classes of iron, lie in bands, and when divided into definite areas by drawing approximate boundaries produce the center chart (Fig. 3). This chart then shows the bands that each class of iron fell into with each surface to volume ratio or step thickness. The tensile strengths expected at various hardnesses from the irons in this foundry are shown in the right-hand column. With this chart, then, knowing the surface to volume ratio of a member of a casting and the tensile strength required in it, the grade of iron which will produce the required

strength can be chosen. The BHN of the member can also be predicted from the same chart.

Machinability: In order to extend the chart to include machinability, these step blocks had to be machined in various manners to obtain data useful to the machine shop.

Power Used: A 1/4-in. starting hole was drilled 1/8-in. deep in each step of all blocks. Then a 3/4-in. diameter hole was drilled following these starting holes, using a drill press and mechanical feed. The feed was set at 0.006 in. per revolution and the drill speed at 190 rpm. A recording power meter was attached to the drill press and the power factor recorded for each test. Each drilling was continued until a constant power reading was obtained.

After every five readings a test was made on a block of cold rolled steel in order that allowance could be made for any wear on the drill. It was found that through the experiment the power reading for the cold rolled steel gradually increased. This factor was considered when plotting the results of the experiment. These results are shown in Fig. 3 under "power used," the factor being based on a reading of 100 for cold rolled steel. It is then evident that gray iron of BHN 170 required 75 per cent as much power in drilling as does cold rolled steel.

Drill Speed: Using the same drill press and setting the feed at 0.004 in. the blocks were drilled again in the same holes, this time increasing the speed until the drill burned. A freshly sharpened drill was used for each test. In cold rolled steel the drill burned at 500 rpm and the results for iron are shown in the chart. Thus gray iron at 170 BHN can be drilled at twice the speed of cold rolled steel drilling.

Metal Removal Rate: The large step blocks were then turned down on a lathe until round and, with the depth of cut set at 0.015 in., the blocks were machined at increasing speeds until the tool burned, using a new tool for each test. Then using the maximum metal removable for cold rolled steel as 100, the iron falls into the relation shown in Fig. 3 under "metal removed." Thus in iron at 170 BHN the metal can be removed at three times the removal rate of cold rolled steel.

Machinability tests have been described [9, 10, 11] as

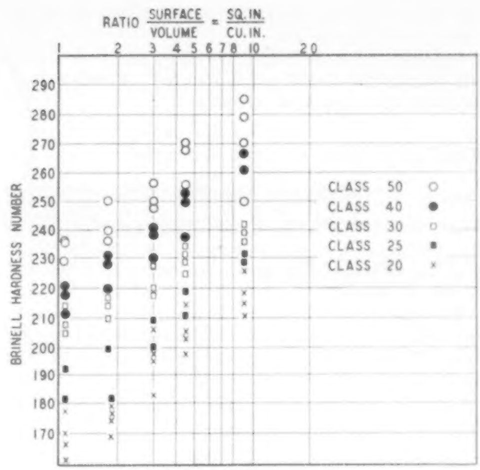


Fig. 2—Hardnesses obtained on steps of each block are plotted against surface/volume ratios. Approximate band boundaries of the irons are drawn in Fig. 3.

the means of estimating the machinability of various materials, but the foregoing tests were selected as suitable for the work done in this shop. Boulger's Table 1,[11] shows cast irons of 230 and 175 BHN as having ratings of 50, 65, and 80. Cast irons of these same hardnesses showed ratings of 40, 51, and 80 in the metal removal test, while in the drill speed test the ratings are in the ratio of 48, 53, and 80.

Summary and Application

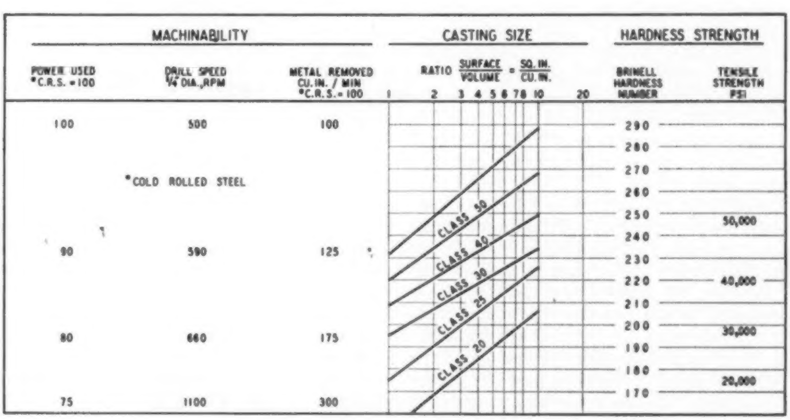
Using the combined chart (Fig. 3) the proper grade of iron can be selected to suit the casting size:

(1) Decide what strength is required in the member, choosing strengths closest to the A.S.T.M. Grades 20 to 60.

(2) Estimate the surface area/volume ratio of a 1-in. length of the member in terms of sq. in./cu. in.

(3) Using the chart, determine the class of iron re-

Fig. 3—A grade of iron suitable for the casting size and the desired strength and machinability can be selected by reference to the combined chart.



quired for the job, checking that the member will be satisfactorily machinable.

Example 1: Fig. 4 shows a flat plate in which a tensile strength of 40,000 psi is required. Total surface area of a 1-in. length of this plate

$$2\,(1\times2)+2\,(1\times1/2)=5 \text{ sq. in.}$$

Total volume of a 1-in. length of this plate

$$2\times1\times1/2=1 \text{ cu. in.}$$

$$\text{Surface/Volume}=5/1=5$$

From the chart, A.S.T.M. Class 25 iron is required for this member. It will have approximately 220 BHN and the machinability which accompanies 40,000 psi tensile strength.

Example 2: Fig. 5 shows a gear blank section in which the spokes are required to withstand 50,000 psi in tension. Total surface area of a 1 in. length of this spoke is

$$2\,(2\times1)+2\,(1\times1)=6 \text{ sq. in.}$$

Total volume of this length is

$$2\times1\times1=2 \text{ cu. in.}$$

$$\text{Surface/Volume}=6/2=3$$

From the chart A.S.T.M. Class 50 iron is required,

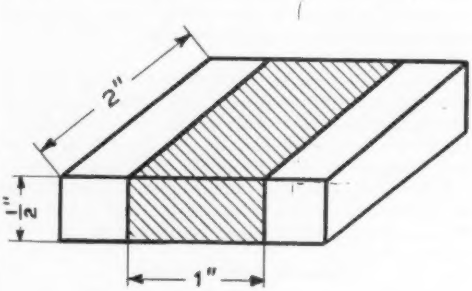


Fig. 4—The method of calculating surface/volume ratio and selecting an iron of the proper strength and machinability for this casting is shown in Example 1.

with approximately 250 BHN and the machinability which accompanies iron of 50,000 psi tensile strength.

This chart serves the purpose of the foundry personnel in designating the proper grade of iron. It also serves as a useful tool for the design engineers and estimators in the plant. The design engineer is able to comprehend the principle of strength vs. section thickness and thus design iron castings more accurately. He realizes that if he increases the thickness of a casting to gain more strength, he has defeated his purpose by lowering the cooling rate or surface/volume ratio.

The estimator can set metal prices and machining times more accurately. He becomes conscious of the decrease in the machinability with increasing strengths and hardnesses and adjusts his estimates accordingly.

It must be pointed out that although the irons produced in this foundry conform to irons described in the references [3, 4, 5, 6, 7, 8,] any foundry attempting to set up a similar chart should conduct the experiment described in order to properly predict the properties to be obtained in their castings. Inoculation procedures, residual alloys, shakeout times and many other factors will influence the properties obtained.

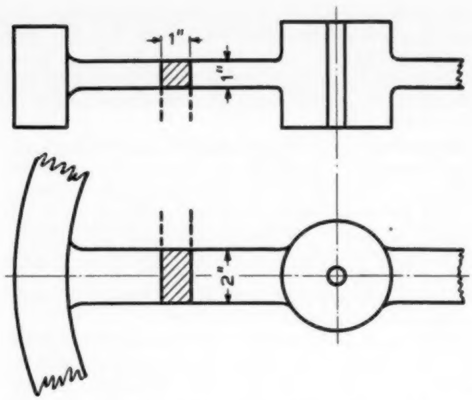


Fig. 5—Calculation of surface/volume ratio and selection of the proper iron for 50,000-psi spoke section of this gear blank casting is shown in Example 2.

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Copies of '51 Hoyt Lecture Available

Now available are copies of the 1951 Charles Edgar Hoyt Annual Lecture, "*Management of Industrial Research*," presented at the 55th Annual Convention of the American Foundrymen's Society in Buffalo last May by James C. Zeder, director of Engineering and Research, Chrysler Corp., Detroit.

In his lecture, Mr. Zeder covers such varied phases of research as origin, foundations, types of research, functions of the research director, financing, operation and benefits. Copies of the lecture which will appear in the forthcoming A.F.S. Transactions, Vol. 59 (1951) are available at $0.25 to A.F.S. members and $0.40 to non-members from A.F.S. Headquarters, 616 S. Michigan, Chicago 5.

A.F.S. REPORT TO THE MEMBERSHIP 1950-51

GUIDED BY POLICIES laid down by its founders 55 years ago, the American Foundrymen's Society during the 1950-51 fiscal year furthered its twin objectives—"to promote arts and sciences applicable to metal casting manufacture" and "to improve foundry production and the quality of castings."

Throughout the history of the world's largest foundry organization, accomplishment of these aims has been possible only through the combined efforts of all its members working toward a common goal—advancement of the foundry industry.

Cooperation is the keystone of A.F.S. Every membership is held in the name of an individual and each member has an equal opportunity to participate in its activities. Herein lies the fundamental strength of the Society, and its inherent value to the individual, his company and the castings industry.

As in past years, the results of the Society's many activities and projects carried out in 1950-51 are available to the entire foundry industry in the form of improved technology and products.

Chapter Network

The grass roots of the Society lie in the chapters, since more than 500 chapter officers, directors and committee members devote untiring efforts to increasing the knowledge and usefulness of foundry employees and to advancing the science of casting metals. Supporting chapter activities by urging participation of plant employees is good business for any executive.

Prior to opening the 1950-51 chapter season, all chairmen and vice-chairmen were invited to attend the Seventh Annual Chapter Officers Conference in Chicago at A.F.S. expense. These annual conferences have been instrumental in coordinating the work of the Society and in improving the level of chapter activities for the benefit of the membership.

During a single fiscal year, A.F.S. chapters conduct more than 300 meetings and regional foundry conferences, foster apprentice training, sponsor educational courses, and cooperate with educational and civic leaders in stressing the utility of cast metals and the importance of the castings industry. To assist chapters in local program efforts, A.F.S. annually releases separate Film and Speakers Lists, edited for quality and subject diversification.

While the total of 40 regular chapters remains the same, three new student groups joined the A.F.S. chapter network during the fiscal year—Northwestern University Student Chapter, University of Alabama Student Chapter, and Pennsylvania State College Student Chapter. Through this encouragement of youth appreciation for foundry achievement, A.F.S. is contributing "new blood" to the industry.

Building Fund

For many years the idea of a permanent headquarters building for A.F.S. has been discussed by men who have been largely responsible for the Society's stature and accomplishments. When the A.F.S. Board of Directors unanimously approved the building project on July 28, 1950, they foresaw a greater and more useful Society, better equipped to serve the industry and the membership it represents.

With Past National President Ralph J. Teetor serving as chairman of a 16-man committee, a program for solicitation and organization was launched. It was felt that the Society's members personally wanted to make the project successful, since the benefits of a technical society accrue first to individuals. At the same time, it was recognized that the chapters of A.F.S. and many foundry companies would desire to contribute, as would the A.F.S. Alumni Group, made up of past officers, directors, medalists, and honorary members.

The generous support of individual members, organizations and chapters far exceeded expectations, with the result that the initial building fund goal of $100,000, originally expected to be accomplished in a three-year period, was met and surpassed by more than $40,000 in the first year, so that a permanent A.F.S. National Headquarters building is now assured.

55th Annual Convention

The most successful non-exhibit A.F.S. convention was staged April 23-26 at Buffalo, with more than 3,000 men of the foundry industry benefiting from the technical sessions, round table meetings, shop courses, lectures, and special events.

The excellent technical program organized by the program and papers committees of the A.F.S. divisions and general interest committees featured many outstanding papers and reports, representing a major influence in bettering foundry practice.

This year for the first time an all-day session, the Symposium on *Principles of Gating*, was sponsored. An attendance of between 1200 and 1400 attests to the success of the Symposium.

Registration fees charged this year were $2.00 for A.F.S. members: $5.00 for non-members. Non-members had the option of applying $3.00 of their registration

fee toward membership dues. All company and sustaining members were given the opportunity to pre-register their employees at the member price, whether the individuals were members or not.

Membership

This year membership regained 2 per cent of the 10 per cent loss recorded last year, to bring the total membership count to more than 9,200. Renewal percentage, too, is encouraging, proving that A.F.S. members are part of a stable industry.

Society Research

Continuing the policy of sponsoring fundamental research, adopted late in the fiscal year 1945-46, the Society makes certain maximum annual expenditures for research projects originating with technical division research committees. Seven projects in effect last year are still in the process of completion. The eighth—a malleable project conducted at the University of Michigan—was completed. The Malleable Research Committee has since launched a research project at the University of Wisconsin on a basic study of the effect of melting conditions, particularly furnace atmosphere, on the subsequent behavior of malleable iron in terms of annealability, development of hot cracks, fluidity, etc.

A.F.S. Committees

Committee officers and technical division officers, are selected by the membership of the respective groups. Members of individual committees are selected by the committee chairmen on the assumption that a committee leader should have the right to choose men who will serve him to the best advantage and accomplish the projects and tasks delegated to the committee.

Any member may volunteer for service on the committee of his choice. All who are willing to share their experience and knowledge while learning from others are urged to apply for memberships.

Quarterly progress reports of special significance on all Society-sponsored research are sent gratis to sustaining members. Results of completed projects and annual progress reports are presented at the Annual A.F.S. Convention. At the 1951 Convention, annual reports on the following projects were made at technical sessions or division business meetings:

Hydraulics of Light Metal Flow into Molds—Aluminum & Magnesium Division.

Fracture Test as an Index of Melt Quality—Brass & Bronze Division.

Centrifugal Casting of Light Metal Alloys—Centrifugal Casting Committee, Aluminum & Magnesium Division.

Fundamentals of Heat Flow During Casting Solidification—Heat Transfer Committee.

High-Temperature Properties of Molding Sands—Sand Division.

Relation of Cores to Hot Tearing—Steel Division.

Risering of Gray Iron—Gray Iron Division.

Available early in the 1950-51 fiscal year, the color-sound film *"Fluid Flow in Transparent Molds—II,"* an annual report on the Aluminum & Magnesium Research Project, has been widely used at plant, chapter and regional meetings.

More than 500 men serve on the approximately 100 A.F.S. technical committees. New committees activated during 1950-51 for pursuing specific problems include the Steel Division's Quality Control Committee and several sub-committees of the Green Sand Properties Committee of the Sand Division. Faithful service, willingness to help others while learning and constant interest in the Society have made the work of A.F.S. committees outstanding. The membership owes a debt of gratitude to all committee members.

Liaison among the national committees of the Society is maintained through the Technical Correlation Committee. Members of this committee are the chairmen and vice-chairmen of the eight divisions and the chairmen of general interest committees.

Highlights of the 1951 Annual Meeting of the Technical Correlation Committee were reported in the July issue of AMERICAN FOUNDRYMAN (Pages 33-37).

Technical Publications

Demand for authentic information on foundry practice requires a constant flow of new and revised A.F.S. publications. New publications released during 1950-51 include:

A.F.S. TRANSACTIONS, Volume 58
ENGINEERING PROPERTIES OF CAST IRON
GRAY IRON RESEARCH PROGRESS REPORT—II
STEEL SAND SYMPOSIUM

Publications in the course of preparation and scheduled for release during 1951-52 include:

COLLEGE FOUNDRY TEXT
FOUNDRY TERMINOLOGY GLOSSARY
HIGH SCHOOL FOUNDRY TEXT
METALLOGRAPHY OF CAST METALS
STEEL SAND SYMPOSIUM
FOUNDRY SAND HANDBOOK, 6th Edition
SYMPOSIUM ON PRINCIPLES OF GATING
A.F.S. TRANSACTIONS, Volume 59

In addition, all of the Convention papers received prior to a fixed deadline were preprinted in pamphlet form and distributed gratis to the membership upon request. All other publications of A.F.S. are available to members at minimum prices. Publication and pricing policies are established and reviewed annually by the Publications Committee, appointed by the Board of Directors. As soon as a book is published, its future revision and improvement are at once contemplated.

Educational Activities

A.F.S. continued to participate in educational activities at three levels—engineering schools and colleges, vocational and trade schools, and high schools—in an effort to influence young men to pursue foundry careers and to improve foundry education.

In the A.F.S. Apprentice Contest five separate competitions were sponsored: steel, gray iron and nonferrous molding, and wood and metal patternmaking. In addition to awards of $100, $50, and $25 for first, second, and third prize winners in each division, all winners received certificates and first prize winners were brought to the National Convention. Judging of entries is by a group of qualified foundrymen and patternmakers.

Early in 1950, A.F.S. issued a 64-page book, FOUNDRY

RESEARCH PROJECTS, which was distributed as an educational service for the purpose of summarizing research projects suitable for work by college students, research laboratories or foundry classes. A follow-up of this effort is now being launched to determine interest and enlist the cooperation of foundries in areas where recommended projects are now in progress.

The importance of student chapters as a foundry educational stimulus progressed during the past year and 11 student chapters now offer chapter participation benefits. Although student dues are refunded to assist the student groups in the conduct of chapter operations, the members receive complete personal membership benefits. Any bona-fide student or apprentice may join the Society for $4.00 annual dues.

Continually striving to broaden its service to the industry, AMERICAN FOUNDRYMAN last year published technical articles on every phase of foundry technology. The "Letters to the Editor" section has developed as a forum for discussion of papers and as an outlet for short technical communiques.

Increase in non-member readers attests to the fact that the magazine meets commercial standards while continuing as the official publication of the American Foundrymen's Society. The expanded AMERICAN FOUNDRYMAN advertising program, introduced last year, has added to the magazine's industry-wide value through presentation of an increasing array of foundry equipment, materials and services for study and acceptance by readers.

A.F.S. Technical Director S. C. Massari (right) and Gilbert J. Nock, Nock Fire Brick Co., Cleveland, chairman of the A.F.S. Northeastern Ohio Chapter, look over poster urging every foundry to send at least one representative to the 1952 A.F.S. International Foundry Congress & Show in Atlantic City, May 1 through 7, 1952. Already in an early stage of planning, the 1952 International Foundry Congress will comprise an entire week of outstanding technical sessions embracing every phase of the castings industry, social and recreational events. World's leading manufacturers of foundry wares and supplies will exhibit in the concurrent Foundry Show.

Annual Awards

Awards of A.F.S. are recognized everywhere as top goals of achievement. During 1950-51, six men received these coveted honors, presented at the Annual Banquet climaxing the 55th Convention.

Alfred A. Boyles, United States Pipe & Foundry Co., Burlington, N. J., the John H. Whiting Gold Medal.

Victor A. Crosby, Climax Molybdenum Co., Detroit, the John A. Penton Gold Medal.

Thomas W. Curry, Lynchburg Foundry Co., Lynchburg, Va., the Peter L. Simpson Gold Medal.

E. W. Beach, retired, Honorary Life Membership.

Edward J. McAfee, Puget Sound Naval Shipyard, Bremerton, Wash., Honorary Life Membership.

Walton L. Woody, National Malleable & Steel Castings Co., Cleveland, Honorary Life Membership.

American Foundryman

AMERICAN FOUNDRYMAN during the 1950-51 fiscal year continued to advance in readership and technical importance to the foundry industry. Editorial integrity, individual ownership and more than 60 per cent home distribution continued to contribute to the value of "The Foundrymen's *Own* Magazine" as a worthwhile addition to the industry's technical literature.

Governing Principles of A.F.S.

A technical society entitled to represent an industry is bound by standards or principles known to all and zealously guarded by its elected officials. These standards stem directly from, and are limited by, its constitutional authority, governed by five basic principles:

First, *it must rely upon the faith and good will of many men, and solicit their active interest.*

Second, *its integrity must be unimpeachable, constant and proof against any pressure.*

Third, *it must condition the field it serves to consider and to embrace every means of progress.*

Fourth, *it must advocate nothing, but analyze all, selecting for dissemination only that which meets accepted high standards.*

Finally, *it must be prepared to lend its sponsorship to activities which, while outside its own sphere, deserve industry-wide acceptance.*

These principles guide the conduct of A.F.S. affairs today. Foundrymen should know and understand them—they guarantee to every Society member the opportunity to improve himself in direct proportion to his willingness to learn.

Technically submitted,
AMERICAN FOUNDRYMEN'S SOCIETY

INCENTIVES FOR DIFFICULT-TO-MEASURE FOUNDRY OPERATIONS

John R. Walley
Dayton, Ohio

Some foundry operations such as melting, pouring-off, shaking-out, and chipping are difficult and expensive to control as individual incentives, but are ideal when established as a group activity. As an example, experience with shakeout operations indicates that properly established group incentives will reduce hours required for shakeout from 25 to 35 per cent within a short period, and pay the workers proportionately increased earnings.

The first thing to do in establishing a simple, easy-to understand-and-apply shakeout incentive system is to determine the control unit. This may be number and volume of molds shaken out, tons of metal poured, number of charges, or heats. Any one of these four is satisfactory. Take number of charges for example. Use of the term "charges" is to be interpreted as shaking out the molds resulting from the charges.

Use Performance Standards as Base

First determine the man-hours that should be required to shake out molds from one charge. Usually payroll records will reveal total hours required for shakeout, and production sources provide total charges for the corresponding period of time. If possible, list charges and hours by months over at least one year.

The assembled list of charges and hours used in determining an incentive standard should represent normal operating conditions. If any period is unusual in any respect, the charges and hours should be removed from the list. Incentives are most effective when performance standards are based on operating conditions that do not have extreme variations. Management should make every reasonable effort to maintain such conditions.

The performance standard to be used in this example is shakeout man-hours per charge. This standard is determined by dividing total number of charges into total shakeout hours worked during the corresponding period. This assumes that any irregularities in figures have been removed, and that action has been taken to standardize variable operating conditions. It is further assumed that during the reference period, charges divided into shakeout hours worked results in a standard of 2.50 man-hours per charge. This figure would represent 100 per cent efficiency in the incentive plan.

Table Shows Incentive Earnings

An easy-to-read table for rapid determination of incentive earnings can now be established. Simplicity and accuracy must be combined. It is of vital importance that employees be able to compute their own incentive earnings.

The table is developed from a graph, which will serve to show incentive earnings percentages in relation to reduction of shakeout man-hours per charge. The shakeout man-hours per charge can be listed vertically on the left hand column, and incentive earnings per cent horizontally, and the curve plotted accordingly.

The table should show a range in shakeout man-hours per charge, and the corresponding incentive earnings percentage. The range of shakeout man-hours per charge is used in order to avoid having too many pay points. Experience indicates that employees prefer incentives that are computed daily and, when extra earnings are to be paid, they are shown as a full percentage of the basic hourly rate. This is both practical and economical.

An incentive plan should be written up in detail, including an example of how to figure incentive earnings. Also, conditions should be well described, preferably on the basis of sound time studies. Copies of the incentive plan should be duplicated for distribution.

Putting the incentive plan into effect, so that at least 25 per cent reduction in shakeout man-hours is obtained, does not come about easily. Three things must be done:

SHAKEOUT INCENTIVE PLAN

Shakeout Man-hours per Charge	Incentive Earnings % of Basic hourly Rate	Shakeout Man-hours per Charge	Incentive Earnings % of Basic hourly Rate	Shakeout Man-hours per Charge	Incentive Earnings % of Basic hourly Rate
2.500	none	2.099-2.075	17	1.674-1.650	34
2.499-2.475	1	2.074-2.050	18	1.649-1.625	35
2.474-2.450	2	2.049-2.025	19	1.624-1.600	36
2.449-2.425	3	2.024-2.000	20	1.599-1.575	37
2.424-2.400	4	1.999-1.975	21	1.574-1.550	38
2.399-2.375	5	1.974-1.950	22	1.549-1.525	39
2.374-2.350	6	1.949-1.925	23	1.524-1.500	40
2.349-2.325	7	1.924-1.900	24	1.499-1.475	41
2.324-2.300	8	1.899-1.875	25	1.474-1.450	42
2.299-2.275	9	1.874-1.850	26	1.449-1.425	43
2.274-2.250	10	1.849-1.825	27	1.424-1.400	44
2.249-2.225	11	1.824-1.800	28	1.399-1.375	45
2.224-2.200	12	1.799-1.775	29	1.374-1.350	46
2.199-2.175	13	1.774-1.750	30	1.349-1.325	47
2.174-2.150	14	1.749-1.725	31	1.324-1.300	48
2.149-2.125	15	1.724-1.700	32	1.299-1.275	49
2.124-2.100	16	1.699-1.675	33	1.274-1.250	50

First, the shakeout supervisor must be sold on the plan, and he must understand it thoroughly. He should feel that the performance standard is reasonable. Also, he should be able to pass along his knowledge, intelligently and enthusiastically, to the workers.

Second, the shakeout workers should be called together and given a full explanation of the incentive plan, along with duplicated copies of the system. During this meeting every question should be answered, and an agreement reached that the men will give the incentive plan a good trial immediately. In this step local union agreements must be considered when dealing with the workers.

Third, the man who developed the plan should spend much of his time among the shakeout crew during the first few days of incentive coverage so that he can answer questions, report earnings, and keep up morale if necessary. Most incentives and incentive plans fail or succeed in relation to the selling job done during early trials.

Incentive systems, developed and installed as outlined, have stood the test of time, satisfying both management and workers, in situations where the usual methods of measurement and control would be expensive as well as difficult.

CHICAGO VICINITY TO BE LOCATION OF A. F. S. HOME

CHICAGO AREA has been selected as the site of a permanent home for the American Foundrymen's Society. Members of the A.F.S. Housing Committee met on July 11 to tour the Greater Chicago area in search of a suitable location for the proposed Headquarters and to hold preliminary discussions of the type of building to be constructed and examine tentative floor layouts. Recommendations of the Committee have been submitted to the Society's Board of Directors and the Board's decision will be announced to the Society's membership in the near future.

CHARTER SUBSCRIBERS
(June 20-July 20)

INDIVIDUAL CONTRIBUTORS

R. J. Allen, Worthington Pump Co., Harrison, N. J.
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COMPANY CONTRIBUTORS

The G & C Foundry Co., Sandusky, Ohio
Lakey Foundry & Machine Co., Muskegon, Mich.

A.F.S. Reference Linseed Oil Available

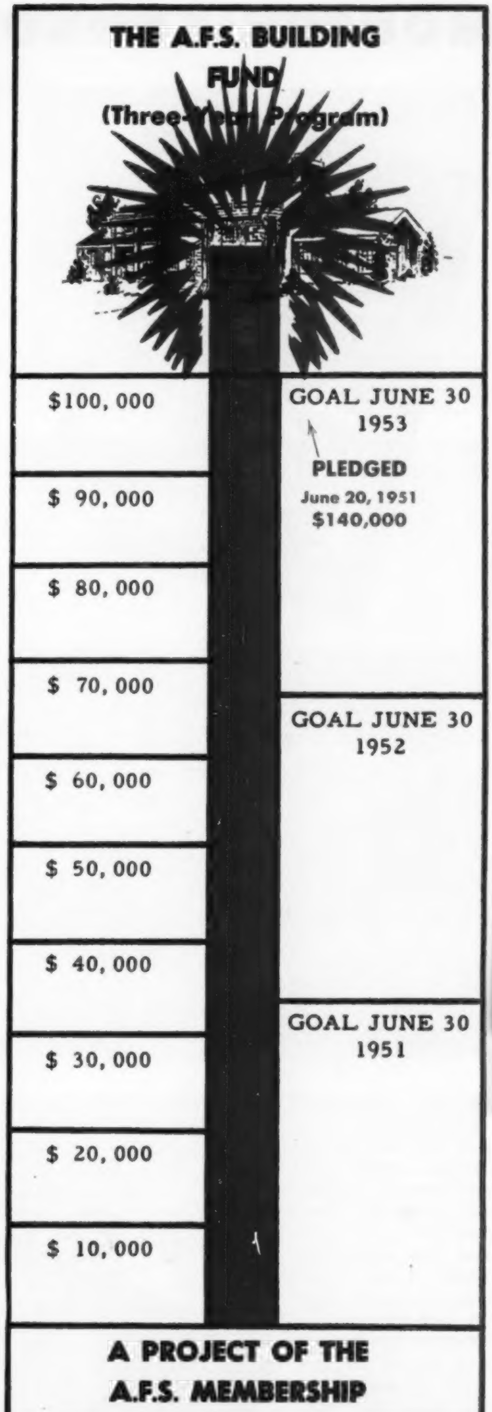
APPROVED as a tentative A.F.S. Standard by the Sand Division Executive Committee, a reference linseed oil core binder is now available commercially.

Specifications for the oil are as follows:

	Min.		Max.
Specific gravity	0.931		0.935
Average lb per gal (77 F)		7.71	
Saponification Value	190		194
Iodine No. (Wijs)	178		182
Acid No.	2		4
Color (Gardner)			5
Viscosity (Gardner-Holt)	A_1		A
Moisture			0.1%
Ash			0.01%

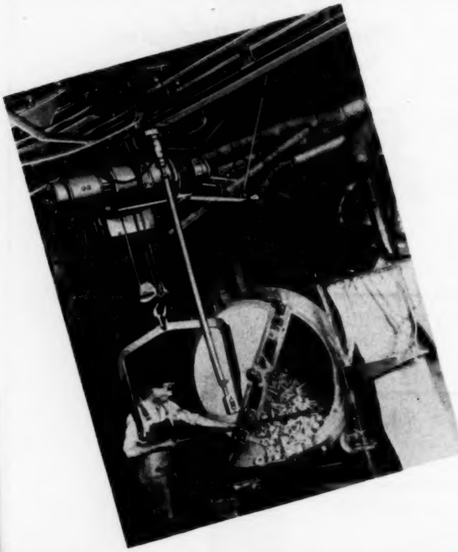
All tests for the above specifications are conducted in accordance with ASTM Specification D-555 (1947). This pure linseed oil is processed to exacting specifications and is relatively stable against changes in these values, but in order to prevent skin formations, three precautions should be observed: (1) store oil at room temperature and avoid excessive heat, (2) keep container tightly closed when not in use, and (3) when container is half empty, transfer oil to a smaller container if it might stand unused for several months.

To avoid skin formations and resulting chemical changes, it is suggested that the oil be purchased in one gallon containers from time to time, rather than in large quantities. The oil is obtainable from Archer-Daniels-Midland Co. (Foundry Products Division), 2191 West 110th St., Cleveland.



MODERN FOUNDRY METHODS...

CLEANING ROOM MATERIALS HANDLING

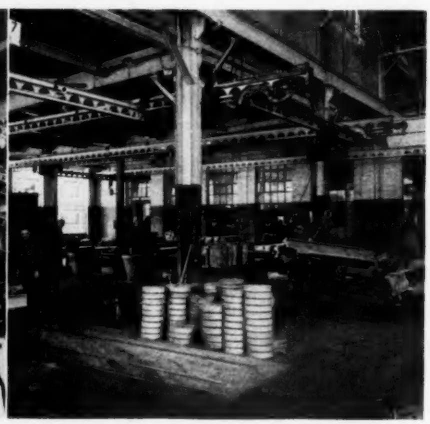


The cleaning room sometimes becomes a bottleneck because mechanization is often considered most important in departments more directly concerned with actual production of castings. If a bottleneck exists or is created, it may be due to cleaning room machines, their layout, or methods used in handling work to and from the machines.

This story—based on a paper presented at the 1950 A.F.S. Convention by N. L. Smith, Link-Belt Co., Philadelphia, and R. J. Wolf, Stone & Webster Engineering Corp., Boston—shows how to use various combinations of equipment and emphasizes the importance of including the cleaning room in the planning of foundry mechanization. The full-length article appears in A.F.S. Transactions for 1950, volume 58, pages 550-556.

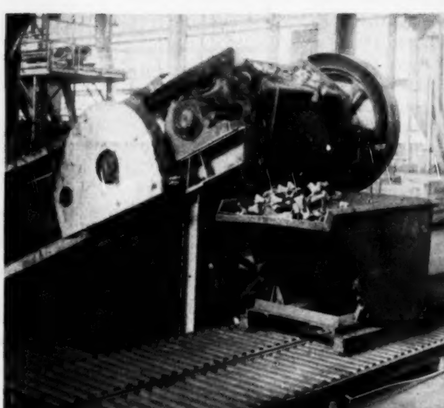
Equipment used in cleaning room materials handling includes: lift trucks, monorails, and light duty cranes, belt

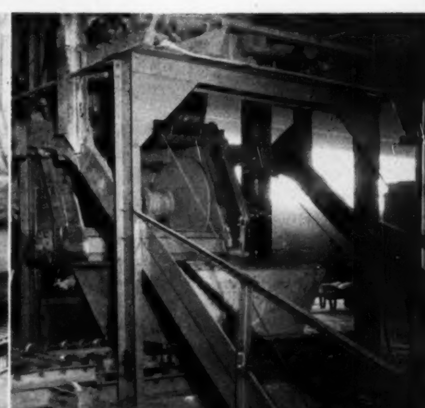
Electric hoist on a monorail for handling castings to and from blast cleaning units in area not conveniently serviced by continuous type conveyers. Castings are transferred manually on monorail by means of barrel-shaped tote boxes.



Long span light duty crane (far left) distributes castings in dump boxes. At right, multiple light duty cranes with crossovers give full coverage in cleaning room. Crossovers make possible transfer of loads from monorail to crane or between two cranes on parallel runways.

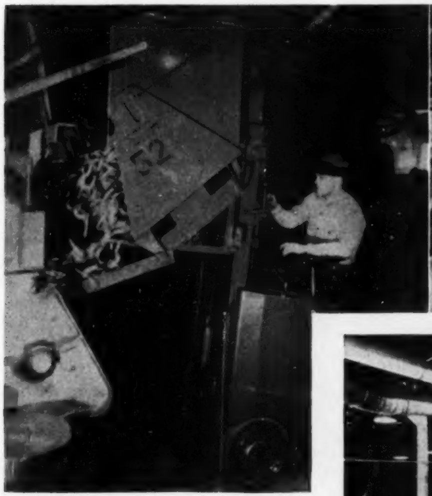
Two applications of roller conveyors provide short run linkage in transportation system between continuous conveyor units. Tote box (near right) can be positioned readily under apron conveyor, is self-dumping without removing from fork truck. Tote box at far right is ready to receive castings from blast unit.



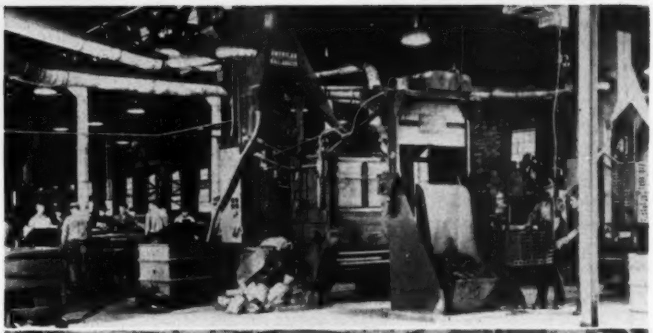


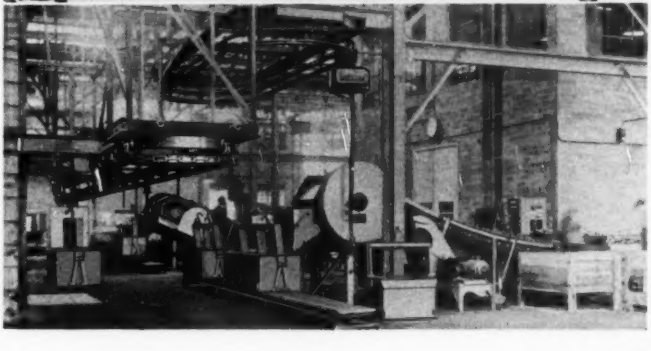
conveyors, apron conveyors, oscillating conveyors, trolley conveyors, and roller conveyors. The foundry, which because of size, wide range of product, available floor space, cost, or other reasons cannot use other types of conveyors can make good use of power lift trucks, monorail and jib cranes, and light duty cranes. These highly flexible units can be used alone, in various combinations, or in combination with other types of conveyors. Gasoline or electric lift trucks are well suited to handling miscellaneous lots of castings in the cleaning room as well as in other foundry

Combination of apron conveyor and wheeled containers hauled by power truck handles material from sand blast machine, gives flexibility to system which includes trolleys.



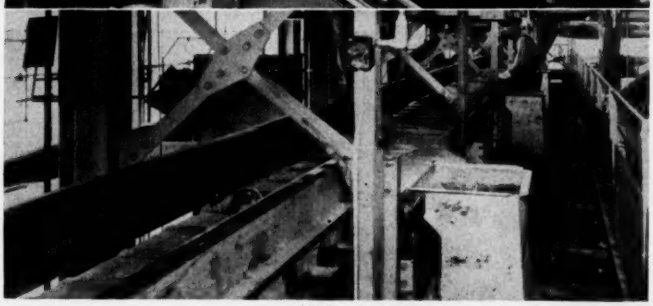
Transfer of castings to and from cleaning unit is facilitated by fork truck and special self-dumping tote box. When released, bottom of box opens, dropping castings directly onto loading apron and into machine.





Combinations of several types of conveying equipment often handle materials better than a single type. Upper picture shows annealed malleable castings coming from the right via monorail to the cleaning unit. Wheeled containers take blasted castings to grinders and presses. In lower illustration castings cool after shaking out onto apron conveyor. Castings are sprued and sorted, sprues come over head of conveyor into buckets. Closed-loop monorail transfers buckets to and from trolley conveyor at left.

MODERN FOUNDRY METHODS...



handling problems. The fork truck has a higher lift than the platform truck, and can pick large castings directly from the floor, but requires pallets or boxes for small castings.

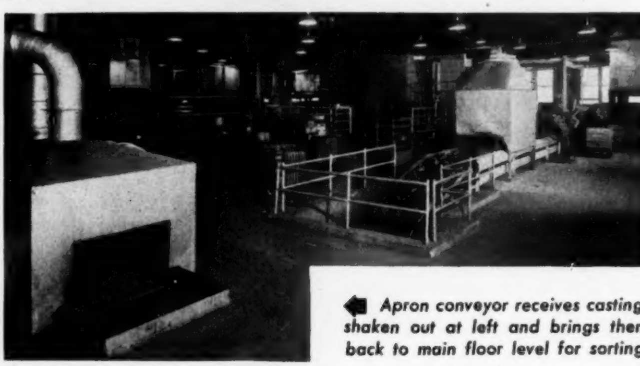
Boxes for either type of truck should be provided with lifting eyes where crane or monorail service is available. Where castings are light it is possible to achieve with a lift truck substantially all that can be accomplished by a combination of trucks and cranes or monorails.

Where individual casting weight requires mechanical handling, floor operated cranes made of special monorail sections offer flexibility. Jib cranes have more limited use but are effective in some areas. Cleaning units should be located so that rough castings can be dumped directly into the unit, cleaned castings directly out into boxes.

Belt conveyors are made of duck impregnated with rubber compounds or heat resisting compounds. Asbestos covers are available. Belts reinforced with wire are available but

Six flat transfer belts deliver castings to grinders. Collecting belt delivers to final inspection and sorting belt. Belts are inexpensive, lend themselves to straight line materials handling. Lower illustration shows apron transfer conveyor for delivery of castings to sand blast unit chutes.

Castings are sprued and sprue removed on cooling apron conveyor in background. Apron conveyor (foreground) brings castings toward right for sorting into boxes for further handling by means of fork trucks.

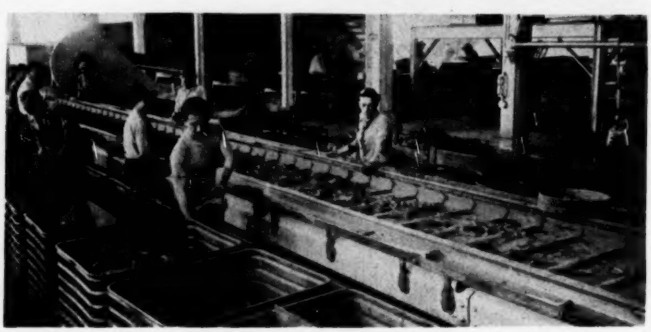


Apron conveyor receives castings shaken out at left and brings them back to main floor level for sorting.

are not required by loads and pulls found in cleaning room service. Wire belts require a clean product and are rarely used in cleaning rooms.

Apron conveyors are made of steel plates, plain or corrugated, mounted on one or two chains. The chains may slide or roll, the roller being an integral part of the chain.

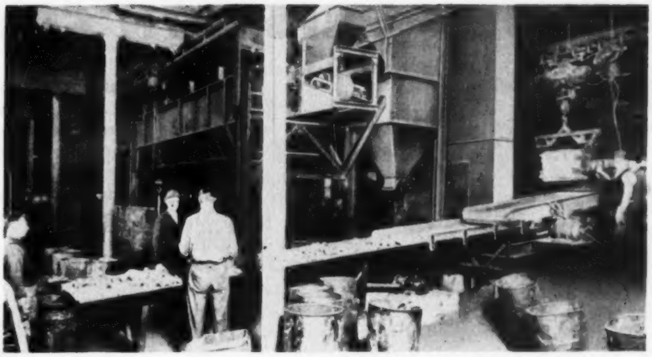
A one-piece trough that has an oscillating motion makes up the oscillating conveyor. Trolley conveyors carry loads suspended from two- or four-wheel trolleys towed by a chain



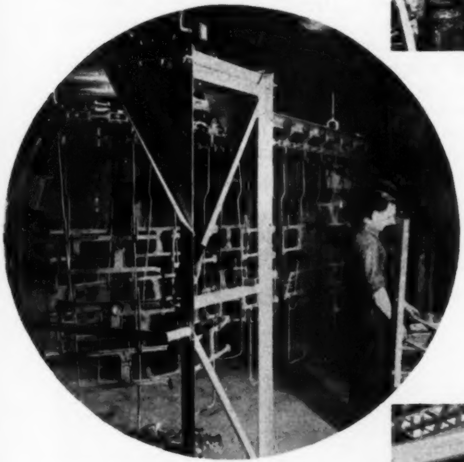
...MODERN FOUNDRY METHODS

on overhead I-beam tracks. Roller conveyors consist of tubes containing antifriction bearings turning on stationary shafts. They are generally manually or gravity operated but may be powered for unusual lifts or heavy loads.

In a foundry where operations are uniform and the sequence of operations fixed but machines are scattered, the trolley or monorail conveyor can be profitably selected. If straight line operation can be obtained between two points and operations are uniform, a belt, apron, oscillating, roller, or trolley conveyor can be used.



Oscillating conveyor moves malleable castings to left after shakeout from annealing pots on screen at right. Belt delivers reclaimed packing to overhead hoppers for reuse.



Trolley conveyor delivers castings from foundry to inspection department. Trolley or monorail conveyor is often selected for use where machines or departments are widely scattered in the plant.

Two examples of trolley conveyor use to handle materials between distant points and utilize overhead space. Lower photo also shows two-mold car-type mold conveyors. Trolley conveyor paths can vary widely, both horizontally and vertically, and discharge and pickup can be automatic.

Choice of equipment is governed, not only by the layout required by available space and existing equipment, but also by temperature, size, and character of materials handled. Castings at elevated temperatures may have to be handled on steel-bottomed conveyors or in metal tote boxes. Since initial cost and maintainance cost are generally lower for belt than for oscillating or apron conveyors, it is wise to determine whether the material to be handled is within a safe temperature range for belts before final choice.

A compromise between the most highly desirable equipment for a given job and the next best may have to be made in instances where costly building changes might be involved in the first selection.

FOUNDRIES JOIN IN DEVELOPING CUPOLA EMISSION CONTROL UNIT

Thomas L. Harsell, Jr.
Consultant
Hermosa Beach, Calif.

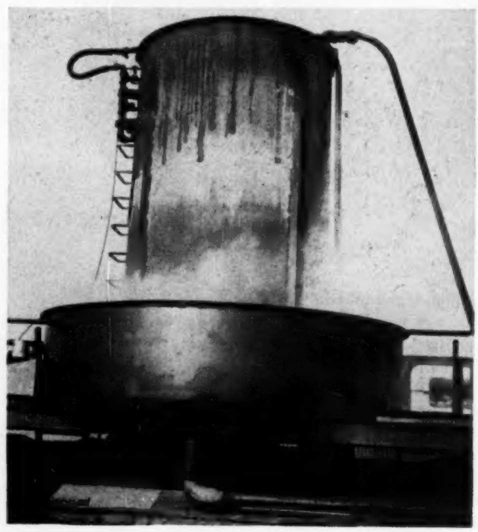
Tests for particulate matter emissions were conducted on three representative cupolas in the Los Angeles area, and various types of dust collection equipment were pilot plant tested. A full-scale wet washer was installed, and the system was later redesigned to include a second washer, water cooling tower, and baghouse. The dust loss was within the allowable limit.

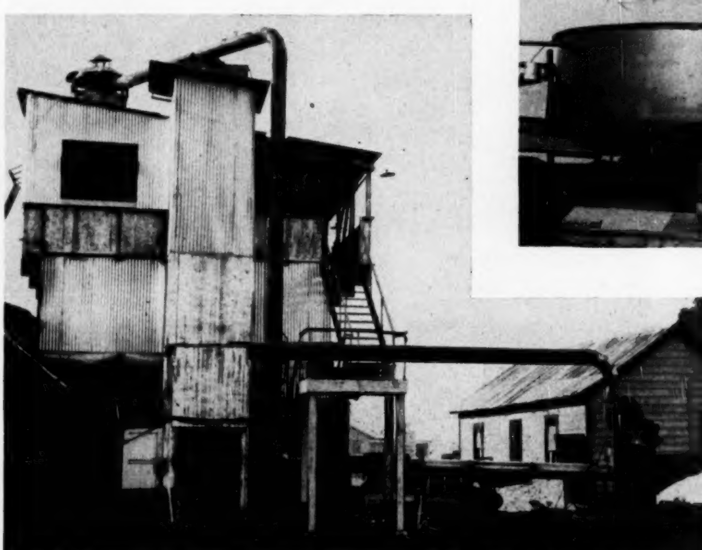
A CUPOLA DUST CONTROL UNIT constructed of 16 to 24 gage galvanized sheet metal has been in successful operation for over 6 months on the 36-in. ID cupola of Apex Steel Corp., Ltd., Los Angeles. Developed out of the $80,000 research and testing program of the Gray Iron Foundry Smog Committee of Los Angeles, the system still handles cupola emission very efficiently even though foundry production has increased beyond the rated capacity of the baghouse, according to Apex Vice-President D. L. Robertson.

Organization of the committee and development of the dust collecting unit started with the enactment in June 1947 of Assembly Bill No. 1 by the California State Legislature. The law provides for creation of an air pollution control district in each county and describes in general terms the conditions to be corrected. It provides a permit system under which it is necessary to obtain (1) a permit to install a piece of equipment which causes or reduces, or may cause or reduce air pollution, and (2) obtain an additional permit to operate. The law sets up penalties for failure to comply with its provisions. It establishes a hearing board for the purpose of reviewing and the granting of variances to the regulation.

In Feb. 1948 the Air Pollution Control District of Los Angeles County adopted regulations which limited the emissions of particulate matter to 0.4 grains/cu ft, lead and zinc to 0.035 grains/cu ft, and sulphur compounds (calculated to SO_2) to 0.2 per cent by volume of the effluent gases. Opacity readings were limited to No. 2 Ringlemann, but higher readings were allowed for less than 3 min each hour.

These rules were made more stringent in April 1949 by adopting the "process weight per hour" formula, and limiting the solid products of combustion to 0.4 grains/cu ft of gas calculated to 12 per cent CO_2. The "process weight per hour" method of determining the





Above—Full-scale wet washer was installed and tested on top of the cupola of Apex Steel Corp., Los Angeles.

Left—Unit for determining amount of particulate matter in cupola emissions requires straight runs of duct into and out of the test unit in order to obtain accurate samples.

allowable discharge of matter fixed a relationship between the discharge permitted and the weight of material entering into the process. It is under these laws that Los Angeles County is now regulated.

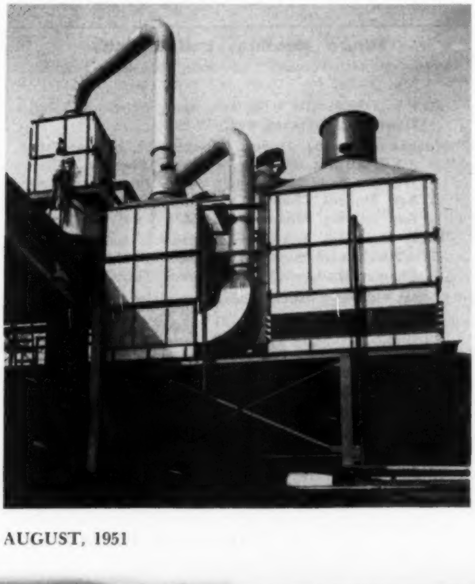
In May 1948 a group of 38 foundries formed the "Gray Iron Foundry Smog Committee." The membership has since expanded to include 45 of the 54 operating foundries in the area. It was felt that the foundries could better solve their problem by combining knowledge and effort. One of the first projects undertaken by the committee was the employment of six recognized laboratories to determine the characteristics of emissions into the atmosphere from the cupolas of Compton Foundry, American Brake Shoe, and Lincoln Foundry Corp. as representative of the small, medium and large cupolas in the area.

Through these lengthy tests much knowledge was obtained which has been of constant help and a guide to the future activities of the committee. Results from the three selected cupolas showed that the particulate matter emissions varied from approximately 0.8 to 1.6 grains/cu ft of stack gas calculated to 60F, or from 13 to 35 lb per ton of iron produced.

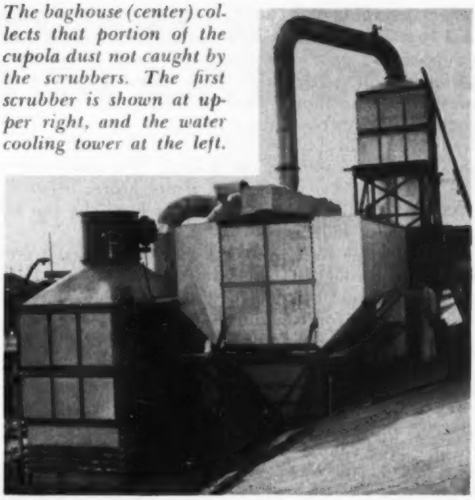
Although only three cupolas were tested, it was concluded that all were in violation with regard to particulate matter and opacity, but were within the regulation with regard to sulphur, lead and zinc emissions. It was concluded that some type of remedial equipment must be designed to reduce the particulate matter to within limits. The author was retained in October 1949 to determine types of equipment on the market which would meet the law.

Pilot plant tests were conducted at Compton Foundry on two dry centrifugal collectors, and six wet-type collectors. Results showed that the best efficiency obtained from the dry collectors was 40 per cent, and that 70 per cent could be expected from the more effective wet collectors compared to an efficiency of 91 per cent required to meet the regulation. A specially built redwood electrical precipitator pilot plant was tested and found to operate within the law. However, the cost of a full-scale unit did not warrant use of this equipment.

Dust collection system includes: Upper left—first scrubber installed on top of cupola stack; center—second scrubber into which cupola gases pass from the first unit; right—water cooling tower which cools the water for recirculating through the scrubbers. Baghouse is located behind second scrubber and cooling tower.



The baghouse (center) collects that portion of the cupola dust not caught by the scrubbers. The first scrubber is shown at upper right, and the water cooling tower at the left.



In conjunction with the pilot plant tests a full-scale wet washer was installed on top of the cupola at Apex Steel Corp., Ltd. (this should not be confused with the present unit). After many tests and arrangements of sprays and baffles, it was found that the unit would reach a maximum efficiency of only 40 per cent.

At the start of the testing program the cost of baghouse equipment had placed it as a probable solution only as a last resort. After completion of the wet scrubber tests, a pilot plant baghouse was built and tested using different types of glass bags. Results showed that all bags tested would comply with the law.

Build Test Baghouse

After testing a wet scrubber designed and fabricated by a local concern, that company built a baghouse using cotton bags and installed it on the discharge of the scrubber. Part of the hot gases by-passed the scrubber to raise the temperature of the bags to 150F. Observation of this system brought about the decision to install a full-scale unit.

Culminating the $80,000 research and testing program, the Gray Iron Foundry Smog Committee of Los Angeles contracted for the design, fabrication and erection of a unit to handle the gases from the 36-in. ID cupola of the Apex Steel Corp., Ltd. This unit was placed in operation on Nov. 20, 1950 at a cost of nearly $20,000. Except for superstructure it is constructed entirely of 16 to 24 gage galvanized sheet metal.

The first step in the collection of the emissions is the installation on top of the cupola stack of a rec-

tangular scrubber measuring 6 by 6 ft by 13 ft high and containing many closely spaced baffles. Into this scrubber 175 gpm of recirculated water is pumped through many nozzles at 10 psi pressure. This water is prevented from falling into the cupola by means of cones placed directly above the stack opening. The water collects in the bottom of the scrubber and drains into a sump located on the ground. The gases enter the bottom of the scrubber at temperatures between 1700 and 2300F, and are discharged from the top at an average of 130F.

After leaving the top of the scrubber the gases are conducted through a 21-in. diameter duct into the bottom of a second scrubber of essentially the same dimensions and construction as the first. Recirculated water is used in this scrubber at the rate of 75 gpm. The gases are discharged from the top of the scrubber at an average temperature of 100F. Tests show that the volume of gases leaving this scrubber is 5100 cfm at 100F and contains 6.2 per cent moisture.

The large volume of water involved is recirculated not only to save water costs but to prevent overloading the sewer system. The hot water collected from the two scrubbers reaches a maximum temperature of 150F and is collected in a concrete sump measuring 8 by 6 ft by 3½ ft deep. Screens in this sump prevent large particles from entering the 10-hp pump which passes the water into a galvanized metal, forced draft, cooling tower measuring 6 by 10 ft by 15 ft high.

Water Cooled and Recirculated

The water entering the cooling tower is sprayed at 10 psi pressure over baffles to insure cooling. A 10-hp fan located at the top of the cooler draws air through the tower. Water evaporation in the tower is approximately 15 gpm. The water is cooled from an average of 145F to 98F.

The cooled water drains from the bottom of the cooling tower to a sump measuring 4 by 6 ft by 3½ ft deep. Make-up water is added and a 10-hp pump distributes the water to the two scrubbers.

From the exit of the second scrubber the gases are reheated to 190F by means of a natural gas air heating chamber. This step "dries" the moisture in the scrubbed gases so that they may pass through the baghouse without depositing moisture on the bags.

The mixture of the hot air gases and cupola gases passes through a centrifugal fan powered by a 7½-hp motor. The fan thoroughly mixes these two gases and conditions the mixture prior to entering the baghouse.

The baghouse, measuring 14 by 8 ft by 12 ft high, is the first of this particular type to be built. It was known from the pilot plant model that the dust would cling to the cotton fabric to such an extent that normal bag shaking would be insufficient to clean the bags. To remedy this difficulty the cotton bags were designed in an "envelope" fashion, each measuring 6 ft high and 3 ft deep and placed one beside the other on each side of the baghouse for easy access to each bag.

The gas entering from a manifold in the top of the baghouse must pass through the envelopes before being discharged into the atmosphere. Both ends of the baghouse are blanked off with galvanized metal.

The bag shaking mechanism as originally planned was powered by a 1-hp motor and was designed to give the maximum amount of shaking to the bags. The bags were to be shaken prior to each heat. However, after a few days of operation it was apparent that no amount of shaking would remove the dust from the bags. A method of cleaning the bags by blowing air at high pressure through the cloth was devised, thus blowing the dust off of the bags and into the baghouse hopper.

Although this method satisfactorily cleaned the bags, sufficient dust would deposit on the bags after 45 min to 1 hr of operation that puffing due to resistance was noted at the charge opening. To overcome this, a by-pass was installed between the exit of the fan and the base of the water cooling tower. Tests conducted on the system prior to the by-pass installation showed a cupola stack loss of 43.3 lb of dust per hour, a loss of 20.9 lb per hour after the first scrubber, and 16.1 lb per hour loss after the second scrubber. The allowable loss for the operation was 10.52 lb per hour.

These results show that over 50 per cent of the gases could by-pass the baghouse (which was assumed to be 100 per cent efficient) and still be within the regulation. With this by-pass, as the bags become plugged a larger portion of the gases from the fan exhaust pass through the water cooler. During the latter part of the heats it was determined that 50 per cent of the gas is thus by-passed. By this means cupola can be operated for 3 hr without shutting down for bag cleaning.

Under the above conditions the Air Pollution Control District on Feb. 2, 1951 made tests on the unit. Results showed an average dust loss out the baghouse of 0.3 lb/hr, and an average dust loss out the water cooler of 6.0 lb/hr. Allowable loss was 9.4 lb/hr. As a result of these tests a permit to operate was granted.

Cost figures for operation exclusive of labor, have been determined for an average 3-hr operating day as follows:

Gas	1.87
Soda ash (for neutralizing the water)	1.60
Electricity	1.43
Water	0.59
Total	$5.49

NAME SAFETY, HYGIENE AND AIR POLLUTION EXPERT TO A.F.S. STAFF

INITIAL STEP in launching the American Foundrymen's Society's new industry-sponsored, long range foundry Safety, Hygiene and Air Pollution Program is the addition of Kenneth M. Morse, former chief of the Illinois Department of Health's Bureau of Industrial Hygiene, to the Society's staff, effective August 1. One of the first activities in the new program will be the appointment of a committee of industrial safety, hygiene and air pollution experts representing the foundry and foundry equipment manufacturing industries. This committee, working closely with Mr. Morse, will make a critical review of existing recommended industrial hygiene practices, with a view to revising and modernizing them to conform with the best in current thinking on the subject. The committee and Mr. Morse will then prepare new A.F.S. recommended safety, hygiene and air pollution practices in such foundry and related fields as cupola fume control, electric furnace practice, woodworking, welding, etc.

Newest A.F.S. Staff Member Kenneth M. Morse is a native of Boston, where he received his B.S. in mechanical engineering from Tufts College, an M.S. from Harvard University, where he attended the Harvard School of Public Health, majoring in industrial hygiene.

Kenneth M. Morse

Mr. Morse comes to the American Foundrymen's Society directly from the Illinois State Department of Health's Division of Industrial Hygiene, where he was first employed as chief industrial engineer from 1937 to 1943. He has been chief of the Industrial Hygiene Division since that time and has been responsible for administering, developing and promoting industrial hygiene in Illinois. In addition to working closely with industry, Mr. Morse has served for several years as a consultant to the U. S. Atomic Energy Commission's Argonne National Laboratory, and will continue to do so in his new capacity with American Foundrymen's Society.

During his 18 years' experience in both the technical and administrative phases of industrial hygiene, Mr. Morse has worked chiefly in governmental agencies whose programs have been largely based on voluntary cooperation from industry, and has had under his direction engineering, medical, chemical and nursing activities. It is through these programs that he has worked with both ferrous and non-ferrous foundries and knows of their problems.

Mr. Morse's experience includes extensive research into the technical aspects of the air pollution problem as it affects industry. This experience has involved both collection and determination of air pollutants, and development of engineering measures for their control. He is a member of the Cleaner Air Committee of the Chicago Association of Commerce and Industry, is chairman of the Air Pollution Committee of the American Association of Governmental Industrial Hygienists, and chairman of the Radiological Defense Committee of the Chicago Civil Defense Corps.

Mr. Morse is a member of the faculty of the University of Illinois School of Medicine and has made many contributions to the development of improved hygienic conditions for workers. He is also active in many national engineering and industrial hygiene societies and associations. Among these are the American Conference of Governmental Industrial Hygienists, of which he is a past president; American Society of Heating and Ventilating Engineers, Illinois Society of Professional Engineers, and holds a fellowship in the American Public Health Association. He is also a member of Tau Beta Pi, national honorary engineering fraternity. During his career, Mr. Morse has taught the principles of industrial safety and hygiene to medical and engineering students, safety engineers and professional groups and has been active in the development of technical operating personnel. Mr. Morse has also authored or collaborated in the writing of several papers and texts dealing with industrial hygiene and air pollution practices.

A.F.S. Will Be Well Represented At 1951 International Foundry Congress

HEADING A DELEGATION of A.F.S. members to the 1951 International Foundry Congress in Brussels, Belgium, September 10-14, will be National President Walter L. Seelbach, Superior Foundry, Inc., Cleveland. Mrs. Seelbach will accompany him. Others include Past Director and Mrs. C. R. Culling, Carondelet Foundry Co., St. Louis, and Mr. and Mrs. E. C. Hoenicke, Eaton Mfg. Co., Vassar, Mich.

Official exchange paper of the Society has been prepared for the 1951 International by J B. Caine, consultant, Wyoming, Ohio, who has summarized recent developments in risering.

Other North American A.F.S. members who have prepared papers for the Brussels meeting are: A. P. Gagnebin, International Nickel Co., New York; Lester B. Knight, Lester B. Knight & Associates, Chicago; J. E. Rehder, Department of Mines and Technical Surveys, Ottawa, Ont., Canada; W. S. Pellini and R. P. Dunphy, Naval Research Laboratory, Washington, D.C.; V. Paschkis, Columbia University; C. O. Burgess, Gray Iron Founders' Society, Cleveland; James H. Lansing, Malleable Founders' Society, Cleveland; and W. A. Morley, Link-Belt Co., Philadelphia.

AMERICAN FOUNDRYMAN reporter for the 1951 International Foundry Congress is Mr. Rehder.

ZIRCONIUM ALLOY AS MANGANESE SUBSTITUTE IN GRAY CAST IRON

Warren C. Jeffery, Foundry Instructor
College of Engineering
University of Alabama

Small ladle or cupola additions of zirconium as ZrFeSi alloy to gray cast iron were effective in controlling sulphur, reducing hardness and chilling tendencies, and increasing machinability. The reported effects of zirconium in cast iron indicate the alloy is a satisfactory substitute for the commonly used manganese inoculant.

SULPHUR IS CONSIDERED a harmful component in cast iron, and manganese in the amount of 1.7 $\times$ per cent S + 0.35 usually is added to insure freedom from sulphur problems[1]. Over three years ago, at the University of Alabama foundry, the writer began to check the effects of zirconium alloy additions to commercial irons as ladle inoculants. It was noted that very small additions of zirconium alloys to cast iron decreased chill, increased machinability, reduced hardness, refined the graphite, and increased the amount of ferrite in the microstructure.

Table 1 summarizes some of the effects on mechanical properties produced by inoculating an automotive type of gray cast iron with small additions of a ZrFeSi alloy containing 13 per cent zirconium. Although the tensile strength of the base iron was not increased in every case of inoculation, the hardness was always reduced and the tensile strength to hardness relationship of the zirconium-treated irons usually indicated a quality iron.

Machinability: To determine the effect of zirconium additions on the machinability of these automatic cast irons, drill test machinability measurements were made on sections of the 1.2-in. test bars[2]. Table 2 illustrates the improvement in machinability produced by the zirconium inoculation.

Chill: It was consistently observed that normal additions of zirconium alloys to gray cast iron reduced chill in a manner similar to that of other graphitizing inoculants. Figure 1 shows that increased additions of a 13 per cent ZrFeSi alloy produced a corresponding decrease in the chill of a base iron.

Microstructure: When the microstructures of the untreated and zirconium-treated cast irons were examined, it was found that zirconium additions promoted formation of increased amounts of ferrite in the structure, and refined the graphite. Figure 2 shows typical microstructures of untreated and zirconium treated cast irons.

When commercial castings were produced from zirconium-treated irons containing less than 0.10 per cent zirconium, it was found in many cases that the irons were similar to heat-treated irons, and that the thin sections were as soft, and in many cases softer, than the thicker sections. Castings produced from zirconium-inoculated irons and the microstructures of the thin sections are shown in Figs. 3 and 4. The softness of the thin sections was due to production of undercooled graphite and increased ferrite in the microstructure.

To further investigate the graphite refining and ferrite-forming tendency of zirconium, additional

Fig. 1—Graphitizing effects of ZrFeSi alloy (13 per cent Zr) additions in gray cast iron are shown by decreasing chill with increasing amounts of inoculant. Left to right—0.0; 0.10; 0.25; and 1.00 per cent Zr additions.

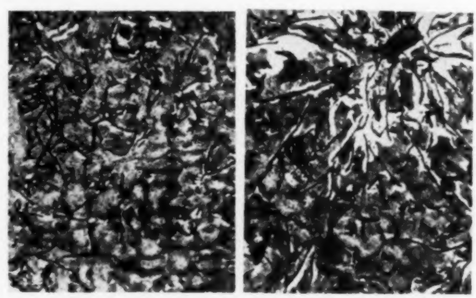


Fig. 2—Microstructures of untreated and zirconium inoculated cast irons. Left—untreated base iron; T.C., 3.33; Si, 2.72 per cent. Nital etch. X100. Right—structure of cast iron inoculated with 0.03 per cent zirconium; T.C., 3.29; Si, 2.82 per cent. Nital etch. X100.

TABLE 1—ZIRCONIUM EFFECT ON CAST IRON MECHANICAL PROPERTIES

Heat No.	Composition, % T.C.	Si	S	P	Mn	Zr Added, %	Trans. Str., lb	Defl., in.	T.S., psi	BHN 1.2-in. bar
42148A	3.33	2.72	0.072	0.24	0.63	None	2,050	0.306	28,300	170
42148B	3.29	2.82	0.073	0.24	0.63	0.03	1,840	0.329	24,900	140
8548A	3.20	2.33	0.049	0.25	0.60	None	2,220	0.255	33,600	207
8548B	3.19	2.38	0.050	0.25	0.60	0.03	2,450	0.316	37,700	187
8548C	3.23	2.58	0.049	0.26	0.54	None	2,160	0.254	32,200	197
8548D	3.23	2.61	0.049	0.26	0.54	0.03	2,360	0.318	33,900	187

TABLE 2—ZIRCONIUM EFFECT ON IRON MACHINABILITY

Sample No.	Hardness*	D. T. M.**	Remarks
C9-1	87	59.3	Production Iron, As-Cast
C9-2	78	67.5	Production Iron plus 0.25% ZrFeSi Alloy Addition

* Rockwell "B" scale, 1/16-in dia. steel ball, 100-kg load
** Drill test machinability, mm penetration/min.

200-lb heats were made in an indirect arc electric furnace. The total carbon, silicon, sulphur, phosphorus, and manganese contents of these heats were held at a fixed level; the zirconium content was varied. Figure 5 illustrates the effect of zirconium content on the final graphite and matrix structure of cast iron.

As observed previously, it was noted that increasing the zirconium content of cast iron refined the graphite and increased the ferrite in the structure, approximately 0.10-0.20 per cent residual zirconium content being required to promote the graphite refining tendency.

Zirconium in the Cupola: Although zirconium is rapidly oxidized, an attempt was made to produce an inoculating effect in cast iron by including zirconium in the cupola charge. An all pig iron charge containing a 5 per cent addition of fist-sized lumps of a 13 per cent ZrFeSi alloy was melted in a 21.5-in. cupola. Another heat was made identical to the first but with the zirconium alloy omitted from the charge. The important results of these cupola heats are listed in Table 3.

The results of this experiment were unusual in that significant amounts of residual zirconium remained in the cupola-melted iron, and an iron was produced which had a drill-test machinability higher than any iron ever examined by the writer.

To check cupola additions of zirconium on a harder and stronger cast iron, charges were made up

Heat 1A
Zr, 0.065%

Heat 1B
Zr, 0.21%

Fig. 5—Effect of varying zirconium content on microstructure of 1.2-in. cast iron test bars. Nital etch. X500.

Heat 1C
Zr, 0.31%

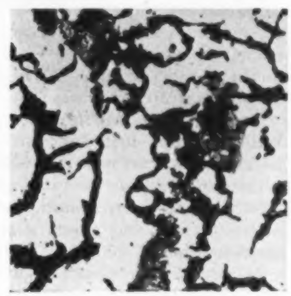
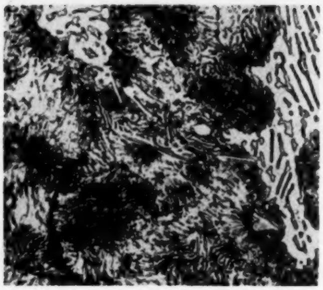


Fig. 3 (left)—Automotive transmission 13-lb casting produced from zirconium-inoculated cast iron, and microstructure of the ½-in. thick flange area. Nital etch. X100.

Fig. 4 (right)—Washing machine gear case casting weighing 15 lb made of zirconium-treated cast iron, and microstructure of the ¼-in. thick flange area. Nital etch. X100.



Composition, %

3.27	T.C.	2.99
2.14	Si	2.96
0.081	S	0.083
0.01	Mn	0.01
0.00	Zr	0.22

Fig. 6—Microstructures of untreated (left) and zirconium treated high sulphur, low manganese synthetic cast irons. Nital etch. X500.

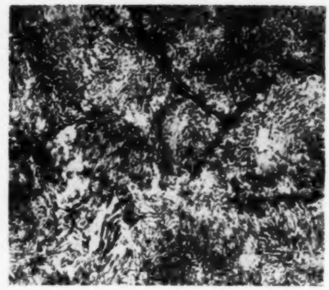


TABLE 3—EFFECT OF ZIRCONIUM ADDITIONS TO CUPOLA CHARGE ON HARDNESS AND MACHINABILITY

Heat No.	Zr, %	BHN, Bar Section, in.* 3/4	1/2	1/4	D.T.M.**
20 A	——	149	153	167	70.4
20 B	0.09	107	107	109	116.9

* Brinell Hardness Number, 10-mm ball, 3000-kg load[3]
** Drill Test Machinability, mm penetration/min.

containing 25 per cent steel and 75 per cent pig iron. Two heats were made; zirconium in the form of cement-bonded briquets was added to one heat. Table 4 summarizes the results. As noted in earlier experiments, the zirconium iron was again softer and more machinable, even though the silicon content of the zirconium treated iron was low.

Zirconium and Sulphur: According to Morrogh and Williams[4] the first function of zirconium when added to gray cast iron is to form a complex sulphide phase and, when the zirconium content exceeds 0.1-0.2 per cent, zirconium carbide appears in the microstructure and exerts a positive refining effect on the graphite.

Microscopic examination of the structures of the various zirconium-treated irons confirmed the above observation. As zirconium appeared to neutralize the sulphur, a synthetic cast iron high in sulphur and low in manganese was made up from ingot iron, graphite electrode, silicon metal, and iron sulphide. After the synthetic cast iron was melted in a 30-lb induction furnace, zirconium in the form of 13 per cent ZrFeSi was added to neutralize the sulphur.

It was found that about 0.20 per cent zirconium would successfully neutralize 0.100 per cent sulphur in an iron in which no appreciable quantity of manganese was present; the same amount of zirconium would not completely neutralize 0.200 per cent sulphur. As zirconium most likely combines with sulphur as ZrS_2 this would be expected as 91 parts of zirconium theoretically combines with 64 parts of sulphur.

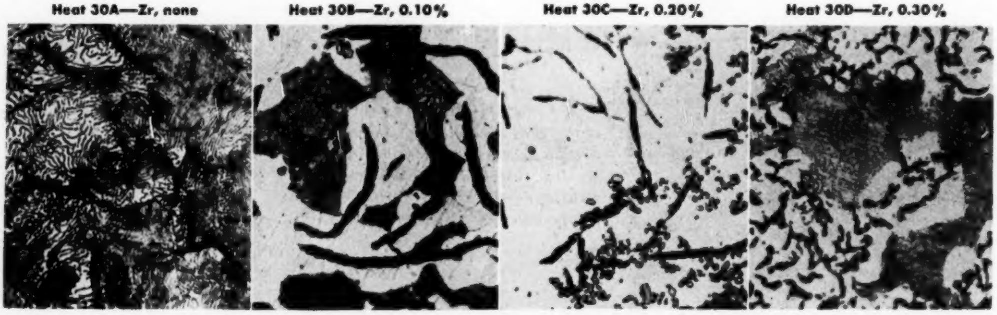
The microstructures of untreated and zirconium treated high sulphur, extemely low manganese, synthetic cast irons (Fig. 6) show how the zirconium treatment eliminated the massive carbides in the structure. The untreated iron was mottled; the treated iron was gray. Chill was reduced from $\frac{7}{32}$ to $\frac{2}{32}$ in. It was noted that the untreated high sulphur, extremely low manganese, synthetic cast irons contained considerable shrinkage and porosity in the test bars. The zirconium-treated irons were sound.

Sulphur Neutralization in Electric Furnace Heats: In order to check the sulphur neutralizing tendency of zirconium in cast irons having a composition similar to those used in commercial foundries, several high sulphur, low manganese melts (200-lb) were made in an indirect arc electric furnace, and zirconium in varying amounts was added to these irons. Table 5 shows the zirconium alloy addition effects on hardness and machinability of the iron.

Examination of the microstructure of these electric furnace heats revealed that increasing additions of zirconium to a high sulphur, low manganese cast iron eliminated the free carbide in the structure,

Fig. 7—Sulphur neutralizing effects of varying zirconium additions are shown by microstructures of high sulphur, low manganese cast irons. Nital etch. X500.

Heat 30A—Zr, none **Heat 30B—Zr, 0.10%** **Heat 30C—Zr, 0.20%** **Heat 30D—Zr, 0.30%**



neutralized the sulphur by forming a zirconium sulphide or sulphide complex, increased the ferrite in the structure and, when sufficient zirconium had been added, refined the graphite structure. The microstructures of typical heats are shown in Fig. 7.

Sulphur Neutralization in Cupola: In an effort to determine the sulphur neutralizing effects of zirconium additions under ordinary foundry conditions, a series of cupola heats was made in which the manganese content of the charge was insufficient to completely neutralize the sulphur. Zirconium in the form of a zirconium alloy briquet was added in increasing amounts to the cupola charge. The silicon, carbon, and phosphorus were, as near as possible, held at fixed levels.

Samples for various tests were taken at identical intervals in all of the heats. The effects of zirconium additions on transverse strength and deflection are summarized in Fig. 8. Type B bars (1.2-in. diameter) were broken on 18-in. centers.

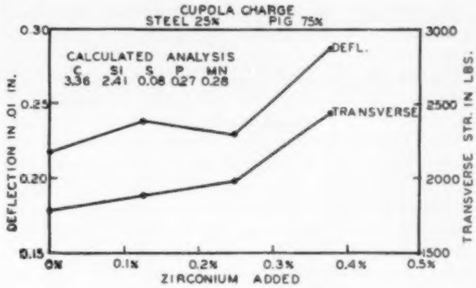


Fig. 8—Deflection and transverse strength of 1.2-in. diameter Type B test bars made from iron treated with ZrFeSi briquet additions to the cupola charge.

Heat 1CL—Zr, none **Heat 2CL—Zr, 0.125%** **Heat 3CL—Zr, 0.25%** **Heat 4DL—Zr, 0.375%**

Fig. 9—Graphite structures of low manganese, normal sulphur gray irons which were treated with ZrFeSi briquet additions to the cupola charge. Unetched. X100.

When sufficient residual zirconium was retained in the cupola-melted iron, the graphite refining tendency was observed in the microstructure. Figure 9 illustrates the effect of zirconium on the graphite structure of low manganese, normal sulphur gray cast iron. Photomicrographs were taken at approximate centers of the 1.2-in. test bars.

The recovery of zirconium in cast iron when added as a ladle inoculant of 13 per cent ZrFeSi alloy was found to be about 75-95 per cent: when added as a zirconium alloy briquet to the cupola charge the recovery was 10 to 40 per cent.

The 13 per cent ZrFeSi alloy is one of the cheapest alloys available to the foundry industry. When the value of the silicon content of the zirconium alloy is considered, the cost of the zirconium addition is insignificant.

The results of this investigation appear to justify the following conclusions:

(1) Zirconium, whether added as a ladle addition or as a part of the cupola charge, is a more potent sulphide former than manganese.

(2) Because of its sulphide forming tendency, zirconium will replace ordinary manganese additions to cast iron.

(3) Zirconium additions to gray cast iron soften the iron by reducing the stability of the carbides and by promoting formation of a ferritic matrix.

(4) ZrFeSi additions to cast iron decrease the chilling tendency, and increasing ZrFeSi additions up to 0.13 per cent contained zirconium causes corresponding decrease in the chilling tendency of an iron.

(5) Additions of zirconium to cast iron refine the graphite structure when present in excess of the amount necessary to combine with sulphur.

(6) Zirconium additions between 0.01 and 0.40 per cent increase the machinability of gray cast irons.

TABLE 4—ZIRCONIUM CUPOLA ADDITIONS EFFECT ON GRAY CAST IRON MECHANICAL PROPERTIES

Heat	Composition, % C	Si	S	P	Mn	Zr	Defl., in.	Trans. Str., lb	T.S., psi	BHN, Bar Section, in. 1.2	1/8	D.T.M.*
21A	3.43	1.86	0.118	0.07	0.57	—	0.36	2,400	32,600	187	229	48.1
21B	3.52	1.41	0.108	0.07	0.53	0.04	0.38	2,070	26,500	163	163	55.8

* Drill Test Machinability, mm penetration/min.

There is, however, an optimum amount of zirconium addition which produces the greatest increase in machinability. This optimum amount seems to occur at approximately 0.20 per cent added zirconium. This optimum may be lower for lower sulphur irons.

Acknowledgment

The writer wishes to acknowledge the assistance and cooperation of E. C. Wright, for encouragement and advice; William P. Whiton and Roland L. LeVaughn, for assistance in making the heats, in making chemical analyses, and in preparing photomicrographs; Dr. W. W. Austin, for his help in determining machinability; E. A. Brandler, Electro-Metallurgical Co., for the supply of zirconium alloys and for assistance in having the Union Carbide & Carbon Corp. develop a spectrographic method for the determination of zirconium in cast iron; and the University of Alabama Research Committee and Production Foundries Div. of Jackson Industries, Inc. for financial assistance.

TABLE 5—SULPHUR NEUTRALIZATION BY ZIRCONIUM ADDITIONS

Heat No.	Composition, % T.C.	Si	P	S	Mn	Zr Added, %	BHN, Bar Section, in. 1.2	3/4	DTM* 3/4-in. Section Step Bar
30A	3.48	1.37	0.04	0.120	0.36	None	212	212	36.3
30B	3.33	2.23	0.04	0.116	0.36	0.1	159	140	45.9
30C	3.29	2.89	0.04	0.108	0.36	0.2	131	126	60.0
30D	3.40	2.09	0.04	0.102	0.36	0.3	166	159	41.6
30E	3.24	2.75	0.04	0.098	0.34	0.4	163	137	39.6
31A	3.41	1.23	0.04	0.213	0.40	None	217	228	Unmachinable
31B	3.31	2.25	0.04	0.198	0.40	0.1	202	217	37.9
31C	3.28	2.80	0.03	0.211	0.40	0.2	192	153	50.0
31D	3.35	1.96	0.03	0.198	0.40	0.3	202	207	35.6
31E	3.31	1.89	0.04	0.196	0.40	0.4	207	223	32.5

*Drill Test Machinability, mm penetration/min.

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2. Wm. W. Austin, Jr. "Improvement of Machinability in High Phosphorus Gray Cast Iron," Transactions, American Foundrymen's Society, vol. 56, pp. 431-444 (1948).

3. Handbook of Cupola Operation, 1946 edition, p. 69, American Foundrymen's Society, Chicago.

4. H. Morrogh and W. J. Williams, "Graphite Formation in Cast Irons and in Nickel-Carbon and Cobalt-Carbon Alloys," *The Journal of the Iron and Steel Institute* (London), March 1947, pp. 330-331.

New, Smaller A.F.S. Pins Available

Contrasted here in actual sizes are the old A.F.A. pin and the new, smaller A.F.S. pin, reduced in size by popular demand of members of the Society. The new ⅜ in. diameter A.F.S. pins will be traded for the old American Foundrymen's Association pins at no extra cost or are available at $1 each from the American Foundrymen's Society National Office, 616 S. Michigan Avenue, Chicago 5, Illinois.

Malleable Founders Discuss Defense Role of Foundry at Annual Meeting

Role of the malleable foundry in America's defense program was the theme of the Malleable Founders' Society's Annual Meeting held at the Homestead, Hot Springs, Va., June 22 and 23.

Speaking at the Society's Annual Business Meeting, MFS President Ralph T. Rycroft, Kencroft Malleable Co., Inc., Buffalo, N. Y., stated:

"Malleable castings are being produced at the highest rate in history. We have been in business 125 years —since Seth Boyden made the first malleable castings in Newark, N. J., in 1826—and we are looking forward to the next 125 years with a high degree of optimism, unless shortages of materials stunt our growth."

A continuing supply of merchant pig iron is an urgent requirement if the ferrous castings industry is going to meet the needs of defense, Mr. Rycroft continued. He urged that producers of pig iron, steel companies and government agencies recognize the need for expansion in pig iron production for the foundry industry. Mr. Rycroft also predicted that "new irons" are not soon likely to replace malleable irons.

New Malleable Founders' Society President Cal C. Chambers, president and general manager of Texas Foundries, Inc., Lufkin, Texas, has had a distinguished industrial and military career. A Colonel in World War I, he won the DSC, Silver Star, Purple Heart and both the Belgian and French Croix de Guerre. Col. Chambers has been with Texas Foundries since 1938 and before that was vice-president and general manager, Southern Malleable Iron Co., East St. Louis.

Officers of the Society for 1951-52 were elected during the meeting. They are: *President,* Cal C. Chambers, Texas Foundries, Inc., Lufkin, Texas; *Vice-President,* F. D. Brisse, Laconia Malleable Iron Co., St. Paul; and *Directors* G. T. Boli, Northern Malleable Iron Co., St. Paul; R. N. Hoffman, Michigan Malleable Iron Co., Detroit; W. H. Moriarty, National Malleable & Steel Castings Co., Cleveland.

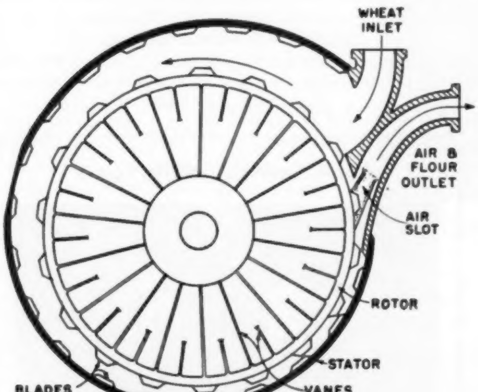
The Society's 1951 McCrea Medal, awarded annually for outstanding service to the malleable castings industry, was presented to Harry A. Schwartz, National Malleable & Steel Castings Co., Cleveland, at the climax of the Annual Banquet, June 22. Cited among Dr. Schwartz's accomplishments in the malleable casting field were his two books, *American Malleable Cast Iron,* published in 1922 and one of the earliest complete sources of information on malleable, and *Foundry Science,* which describes fundamentals of foundry practice. George E. Bean, Eastern Malleable Iron Co., Wilmington, Del., presented the award.

CAST MAGNESIUM ROTOR STANDS HIGH SPEEDS, SHOCKS, STRESSES

THE ONE CRITICAL moving part of a flour mill has been made from a magnesium casting in a design utilizing the light weight and high strength of the alloy. Essentially, the mill consists of a rotor turning in a drum-shaped stator, the working surfaces of each consisting of serrated steel inserts or blades. The rotor is eccentrically mounted in the stator so that the minimum clearance between the two occurs at the point where the flour is discharged. Rotation is in the direction of decreasing clearance.

Other cast parts of the mill include the end-bells and inlet-outlet castings (gray iron) and the bearing housings and supports (magnesium).

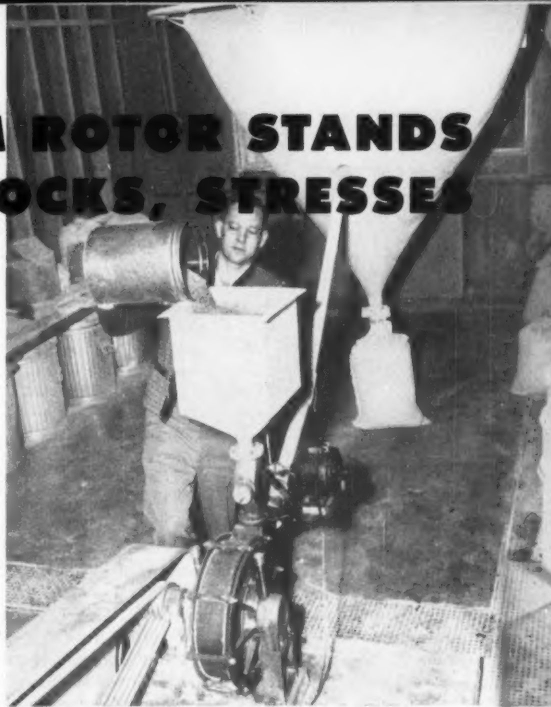
The rotor was designed to a maximum design stress of 2,000 psi, approximately one-fifth of the endurance limit of the material. The expansion of the rim of the rotor was determined under the conditions of maximum stress resulting from both excess speed and heating effects due to agitation of the air by the vanes of the rotor. This indicated a maximum stress in the rim of about one-half of the endurance strength.



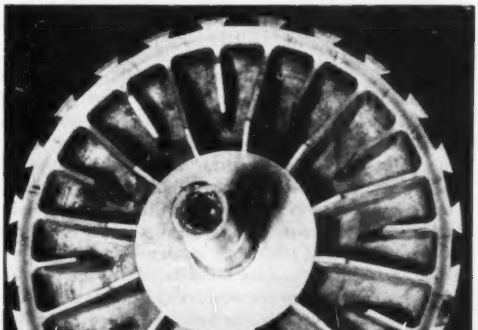
Simplified drawing indicates eccentric position of rotor, greatly exaggerated, in relation to the stator, and the location of the gray iron inlet-outlet casting.

Because of its complex shape (the rotor is required to carry the blades and to act as a fan to blow flour from the grinding chamber into the collector) the rotor is an indeterminate member and absolute checks on stresses are impossible to obtain. The designer, George Pease (now with Boeing Aircraft Co.) used several methods of calculation.

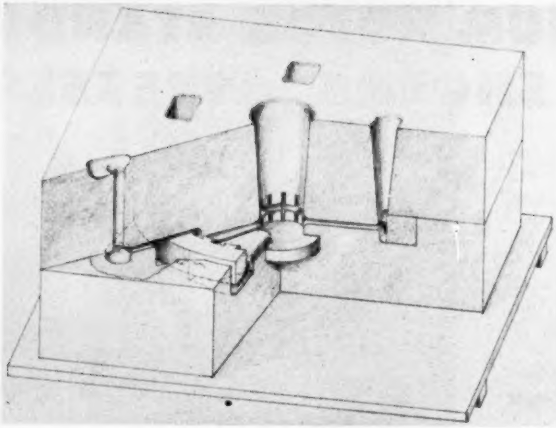
Under normal operation, the rotor rim travels at approximately 25,000 fpm and the 20 steel bars exert a radial load of approximately 3,800 lb each. Despite this the rotor maintains dimensional stability essential with the very small clearances between rotor and

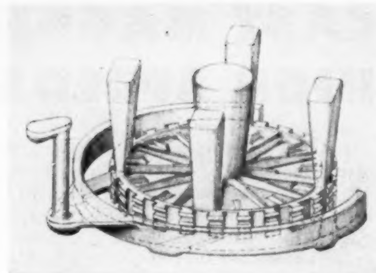


A flour mill rotor is believed to be the first application of cast magnesium to a high-speed, heavily loaded rotating unit. Designed and constructed in the Division of Industrial Research, State College of Washington, Pullman, Wash., this mill and its unique magnesium casting are described in this paper based on the school's bulletin No. 206 and on correspondence with E. B. Parker, director, Division of Industrial Services, R. L. Albrook, director, Division of Industrial Research, E. M. Cramer, now working for the Atomic Energy Commission, and Clarence Cram, molder.



The mill's cast magnesium alloy rotor shows details of cutter-bar installation, ribs, fan blades, and shaft.





Essential features of gating and risering are illustrated in these sketches of the mold and casting for the magnesium rotor. Not shown is a metal strainer which was placed vertically where the wedge-shaped sprue basin meets the circular runner.

stator even under abnormal conditions. Once, while the rotor was turning at its rated speed, a steel roller bearing froze and locked positively. The shock of stopping twisted a steel shaft and splined liner through some 15 degrees but the wheel was undamaged and showed no indication of any permanent deformation.

Minimum dimensions of the rotor were determined essentially by the thickness of metal it was practical to cast. Gating, risering, and chilling employed are illustrated above.

The rotor was cast in green sand in a two-part mold with a 10-in. cope. The synthetic sand mixture used was prepared in the proportions: 100 lb sand (A.F.S. Fineness No. 70), 48 oz western bentonite, 52 oz ethylene glycol, 34 oz sulphur, 34 oz boric acid, and 48 oz water.

The dry sand cores used to make the annular recesses in the rim contained a mixture of the following proportions: 100 lb sand (same type as above), 32 oz sulphur, 10 oz boric acid, 6 oz dextrine, 2 oz resin core binder, 15 oz core oil, and 34 oz water.

Cast Hub Solid

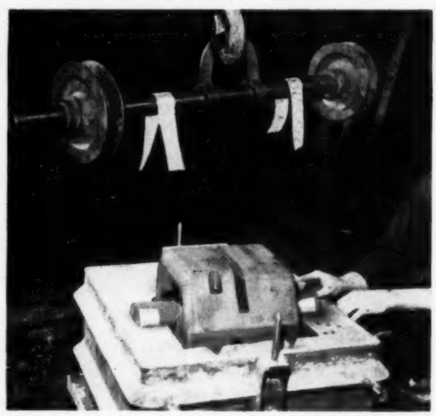
Metal was introduced into the mold cavity through four gates, fed by a circular runner. Gates passed under the cores. An open riser was attached to the rim of the rotor at each gate. Directional solidification in the hub was achieved with an open riser in the cope and a large electrode graphite chill under the hub.

The rotor blades were machined to fit into dovetail slots in the rim of the rotor, hardened to 59-60 Rockwell C hardness, and ground to 0.001 in. interference with the slots. When the rotor was heated, the blades could be easily installed or removed. After assembly, a light cut was ground from the faces of the blades to insure accurate concentricity, and the rotor was dynamically balanced.

The ends of the stator blades and the spacers fit into grooves cut in the inside edge of the cast iron end bells. A steel band tightened around the stator forces the stator blades, by wedging action of the spacers, tightly against the outer edge of the grooves in which they are set. A layer of soft fibrous material such as asbestos prevents actual contact between the steel band and the blades. One end of the band securing the stator blades is fastened to the inlet-outlet casting, the other to a sliding block set in the same grooves as the blades.

The successful application of cast magnesium in the flour mill is one of a number of original researches in cast light metals conducted at the State College of Washington. Another, "*Magnesium Hammer Handles Cast in Permanent Molds,*" appeared in AMERICAN FOUNDRYMAN, June 1950, pages 28-29.

Core Setting With Tape



A practical innovation in core setting is the use of pressure-sensitive industrial "scotch" tape to replace eyes or straps used in lifting heavy sand cores. Recently demonstrated in foundry methods experiments at the University of Minnesota, the tape is attached from an overhead gantry to the core prints and then attached back on itself. After core is seated in the mold, the tape is cut and the loose ends are stuck to the prints. Tape handles cores weighing up to 150 lb.

BRITISH FOUNDRYMEN HOLD 48TH ANNUAL MEETING AT NEWCASTLE

Quality of technical papers presented and discussed contributed to the success of the 48th Annual Conference of the Institute of British Foundrymen, held June 12 through 15 at Newcastle-upon-Tyne, one of Britain's busiest coal mining, shipping and shipbuilding, foundry and manufacturing centers.

As reported by IBF Secretary Tom Makemson, the Conference opened with the Institute's Annual Business meeting, presided over by Outgoing President John Sheehan. President Sheehan awarded IBF Medals to men who had made outstanding contributions to the art of casting metals. Among those honored were: Henton Morrogh, research manager of the British Cast Iron Research Association – the E. J. Fox Medal for "many important researches into cast iron, particularly nodular iron"; A. S. Worcester of Huddersfield–the Meritorious Services Medal for "active service in IBF committee and organization work for many years"; E. S. Renshaw, Ford Motor Co., Dagenham–the British Foundry Medal; and S. J. Sargood, Ford Motor Co., Dagenham–the British Foundry Prize.


Colin Gresty

Outgoing President Sheehan then introduced his successor, Colin Gresty of North Eastern Marine Engineering Co. (1938), Ltd., Walls-end-on-Tyne. Dr. C. J. Dadswell, English Steel Corp., Ltd., Sheffield, and Edward Longden of Manchester were installed as senior and junior vice-presidents, respectively. It was announced that at the Council meeting the previous day, Past IBF President Noel P. Newman had been elected honorary treasurer, succeeding Charles W. Bigg. A resolution was passed expressing indebtedness to Mr. Bigg.

Presidential Address, delivered by Incoming President Colin Gresty, reviewed metallurgical progress in the foundry industry and discussed in detail the progress being made in solving complex ventilation problems and in the suppression of dust, fumes and smoke. President Gresty has done much work in this connection as a member of IBF's Joint Standing Committee on Conditions in Iron Foundries.

Problems dealing with air pollution were also dealt with in two Conference papers. The first, *"Observation and Control of Dust in Foundry Dressing Operations,"* by R. F. Ottignon, K & L Steelfounders & Engineers, Ltd., and W. B. Lawrie, Government Inspector of Factories, was illustrated by a film showing how foundry dust is carried and where it settles. The second, *"Reduction of Dust in Steel Foundry Operations,"* by W. A. Bloor, British Iron & Steel Research Association, did much to focus attention on this important problem and clarify it in the minds of many foundrymen.

The Official Exchange Paper of the American Foundrymen's Society to the IBF meeting was *"Some Thermal Considerations in Foundry Work,"* by Victor Paschkis of Columbia University, New York. This important contribution to the science of heat transfer in the foundry was presented on behalf of Dr. Paschkis by J. F. B. Jackson, director of Research, British Steel Founders' Association, and was the starting point of a most informative discussion.

The French exchange paper dealt with the *"Study of Industrial Applications of Platinum Rhodium Thermocouples,"* and at the same session Dr. R. V. Riley read and discussed a paper on *"Some Factors Affecting the Solubility of Carbon in Iron."* Three of the IBF technical committees presented reports on their work. *"The Evaluation of Soundness in Cast Iron"* was given by Arnold Tipper; *"Synthetic Resins in the Foundry"* by G. L. Harbach; and *"Heat Treatment of Gray Cast Iron"* by T. R. Twigger.

A special session devoted to discussion of light alloys included papers on *"D.T.D. 24,"* by A. P. Fenn; *"Casting Characteristics of Some Aluminum Alloys,"* by D. C. G. Lees of the British Non-Ferrous Metals Research Association; and *"Production Properties of Aluminum Casting Alloys,"* by F. H. Smith of the British Aluminum Development Assn. Newcastle-upon-Tyne engineering foundries were represented by two papers–*"Production of Heavy Castings for Electrical Generating Equipment,"* by N. Charlton of C. A. Parsons & Co., Ltd., and *"The Manufacture of Propellers and Other Castings,"* by C. W. Stewart of C. W. Taylor & Son, Ltd.

Other top Conference papers included: *"Mechanical Charging of Cupolas,"* by W. J. Driscoll; *"A Review of Present-Day Steel Foundry Radiographic Practice,"* by G. M. Michie; and *"Some Present-Day Practices in Patternmaking,"* by B. Levy.

The last day of the Conference, June 15, was devoted entirely to visiting foundries of the Newcastle area. A wide choice of visits was available.

On the social side of the 48th Annual Conference were such events as a reception by the Lord Mayor of Newcastle-upon-Tyne in the town's magnificent Assembly Rooms, built in 1760; The Annual Banquet of the Institute, with President Colin Gresty presiding and John Neill of North Eastern Marine Engineering Co. (1938), Ltd., and Lord Eustace Percy as speakers. Ladies' program for the Conference included an informal social evening, a dinner dance, excursions and visits to points of interest.

Technical level of Conference papers and opportunities for plant inspection were exceptionally good, and some 550 IBF foundrymen and their guests were given the opportunity to discuss their mutual problems.

GRADUATE STUDIES for the

Howard F. Taylor
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A COLLEGE-TRAINED FOUNDRYMAN is a relatively new quantity in industry. In 1888 the chemical engineer was also new to that industry. Since 1888 chemical engineering has become an established branch of engineering. No doubt training engineers for the foundry industry of the future will be just as portentous as it proved to be in chemical engineering; this will surely be true if the foundry is to rise to the proper technological level of a leading, basic industry.

Able scientists at the turn of the century found that chemical engineering was a science based upon definable fundamentals; and so it will some day be that foundry operations will yield to over-all scientific control. Full utilization of science is only a matter of how fast trained men can be produced and how fast they are assimilated into the foundry industry.

Engineering Salary Curves

Consider the history of chemical engineering education in America. The first undergraduate curriculum in chemical engineering was established at M.I.T. in 1888. Figures for 1946 show increasing undergraduate and graduate degrees in chemical engineering and that:

(1) Chemical engineers are better paid than engineers of any other group.

(2) Doctors earn more than masters, and masters earn more than bachelors, though the salary curves for the three come together for men with 30 years' experience. Considering what the bachelor earns while the others are doing graduate work, and the probability that the man who takes graduate work may be a better man to begin with, it does not appear that graduate study results in appreciable financial gain in later years; so the value of post-graduate study seems to be a clear net gain for the employer.

(3) Sherwood[1] points out that "many educational programs are described as designed to train men for positions of intellectual and industrial leadership," but that "this describes the ambitions of the teachers for their students better than it defines the nature of the programs," or from the author's observations, better than it describes the students own aspirations.

(4) The chemical engineering industry is showing clear preference for men with advanced degrees, and more and more schools are improving their graduate programs to meet this demand. As a corollary to this increasing emphasis on graduate work, the future undergraduate curriculum will (and already does at M.I.T.) tend toward a more general education, relegating specialization to the graduate level.

Chemical engineering some 30 or 40 years ago resembled the foundry industry of today reasonably well. For example, a young man graduating as a chemical engineer in 1920, or indeed as late as 1935, faced an industry in which there were too few good jobs to go around; he could seek employment in another field, or he could continue his education at the graduate level. Today the chemical engineering graduate is usually placed many months before graduation in an industry which has long since realized his real worth.

The chemical industry has come of age—primarily on the shoulders of trained engineers and practical scientists. Let the foundry industry learn from this and hasten the assimilation of young, college-trained engineers into the foundry—the transition there will then be quick and fruitful.

Metallurgy Advance Rapid

Another newcomer to the field of science has grown miraculously in recent years. Metallurgy has come a long way from the days when it was associated with the rugged pick-and-shovel prospectors hunting for ore bodies with pack-asses, a wash basin, and some mercury in a chamois bag, to the present day technician using Geiger counters, magnetic detectors, and airplanes.

In delineating the role of graduate study in foundry practice, experiences at M.I.T. have been used. They may or may not be typical, but they are real. First, consider the three standard engineering degrees from the standpoint of technological competence.

Bachelor of Science: A bachelor will have completed four years of intensive training in more or less generalized studies. His only specialization will average somewhat less than 12 per cent of elective subjects taken mainly during his last two years, and a thesis in a field largely of his own choice. Whether the student is a chemical, mechanical, metallurgical, or business and engineering undergraduate, if he is particularly interested in the foundry as a potential career he can take (1) a course of one term in metal processing, of which one-third would be an intensive introduction to foundry practices; (2) a specialized course called foundry engineering, in which broader and more significant principles of foundry practice are taught; (3) one or more terms of "special problems," arranged as a laboratory or library research to suit the student's wishes and the professor's ability to fulfill his wishes; and (4) a thesis of one term's work.

The titles of a few representative bachelors' theses indicate the scope of interest and ambition. The bachelor will continue for many years to represent the main source of trained men for industry; but the numbers of men who go on for further training will surely increase as specialization and the economy of the country dictate.

"Strengthening Gypsum Insulating Riser Sleeves for Use on Non-Ferrous Castings."

"Using Magnesium and its Alloys to Produce Nodular Graphite Structures in High Sulfur Gray Iron."

"The Effect of Titanium on Promoting Soundness in Gun Metal Bronze Castings."

"Design and Development of an Oxygen-City Gas Furnace for Metal Melting."

[1] Thos. K. Sherwood, "Graduate Training in Chemical Engineering," *Chemical and Engineering News*, American Chemical Society, vol. 28, p. 2648, August 7, 1950.

FOUNDRY

The author, far right, oversees the distribution of molten cast iron from the teapot spout receiving ladle in MIT's foundry laboratory. Many of the foundry students are members of MIT Student Chapter of A.F.S., and several have F.E.F. scholarship awards.

In outlining the role of graduate study in foundry practice, the author considers the three standard engineering degrees from the standpoint of technological competence. The paper is the fifth of the series appearing in AMERICAN FOUNDRYMAN dealing with the training of men for the foundry.

"A Study of Methods Controlling Lead Dispersion in Copper-Lead Alloys."

"The Development of an Insulating Material for the Risers of Steel Castings."

"Permanent Molds for Gray Iron Castings."

"Cupola Melting Practice for Gray Cast Iron and Calculation of the Heat Balance."

"Effect of Time Lag Between Degassing and Pouring on the Density of Aluminum Alloy Castings."

"Quality Control Test for Oil Sand Cores."

"The Determination of the Clay Content of Naturally Bonded Molding Sand and Strength Characteristics of Synthetically Bonded Molding Sands with the Aid of the Enslin Apparatus."

"Use of City Gas and Oxygen in Melting Practice."

"An Investigation of the Sales Practices in the Foundry Supply Field."

"A Metallographic Study of Gray Iron Solidification."

"Microporosity and Pressure Tightness of Tin Bronzes."

"Effect of Molten Steel Upon Sand Molds."

"Mechanical Methods of Inoculating Molten Iron with Pure Magnesium to Obtain Nodular Cast Iron."

"Fayalite and the Steel Casting's Surface."

"Shepherd Fluidity Test as Applied to Cast Iron."

"The Effect of Varying Mold Conditions on Cast Bronze."

"The Technical and Administrative Development of an Experimental Foundry Cooperative."

"Progression for the M.I.T. Student Experimental Foundry."

"The Effect of Exothermic Riser Compound on Segregation in Manganese Steel Castings."

"Production Methods Improvement Analysis of the Centrifugal Casting Foundry."

"A Method for Determining Particle Size and Distribution of Naturally Bonded Foundry Molding Sands."

Master of Science: Why does a student decide to obtain a master's degree? In the author's case it was simply in lieu of a good job in the chemical engineering industry in 1937. Since no available job looked particularly good, we decided to continue our studies, improve upon basic training, and wait for better days; but no one came hunting us even then and, quite by chance and good fortune, we landed in the foundry industry. Another might decide to continue to an M.S. degree because (1) he desired more knowledge; (2) wished to better prepare himself for his chosen field; and (3) explore his potential profession more carefully.

All of these are valid reasons important to a potential employer. If the student chooses to be a master for the same reason we did, industry is not alert or does not make the foundry profession attractive enough to the candidate. The next three reasons represent a man eager for more training, and with one year's added maturity.

But what does a masters student learn of value to industry? (1) His course of study is not preordained and he can develop more freely along lines which seem most fitting to him and his teacher. (2) Because of the more liberal, and usually more interesting, nature of his work, conditions are more conducive to individual creative thinking, to the broadening of interests and accomplishments, and to a more balanced feeling for his profession. (3) He can, for the first time, focus his formal courses to fit his needs; and since at least 30 per cent of the student's time can be devoted to thesis, he can do a research problem of considerable scope, which is usually of both practical and theoretical value. (4) In addition, this extra year affords him and industry a chance for mutual appraisal —and industry gets all this for less than \$1000.00 a year in salary as compared to a bachelor.

At M.I.T. about eight masters candidates per year choose foundry practice as their major interest. Among their varied theses are the following:

"Stress-Strain Relation of Foundry Sands."

"Hydrostatic Tension and Shrinkage in Spherical Castings."

"Use of Oxygen for the Melting of Steel in a Coke Furnace."

"Investigation of Sampling and Testing Procedure for Ordnance Steel Castings."

"The Testing and Design of a Cast Non-Ferrous Test Specimen."

"Fluidity Characteristics of Metals."

"The Substitution of Clay for Bentonite in Ferrous Foundry Sands."

"Pinhole Porosity in Plain Carbon Cast Steels."

"The Pressure Feeding of Steel Castings."

Doctor of Science: The doctorate in modern educational institutions has long signified a specialized interest in some particular profession, and often the expectation of going into teaching or research. The increasingly specialized nature and mounting complex-

ities of many of our modern professions demand more and more men with doctoral training.

To many potential employers a doctor of science signifies a long-haired scientist with his head in the clouds and his feet completely off the ground. The engineering doctor of today may actually represent none of these things. He will most surely be well trained, with a broad general knowledge of the fundamental sciences, and he will have proved his ability to do creative thinking and original research. He will have spent three years in intensive study beyond his bachelor's degree, and will have demonstrated his ability to a council of professors by written and oral examinations. But he may still have both feet squarely on the ground.

Graduate Student Opens New Fields

The doctorate who focuses his interest on the foundry industry as a career may have chosen to continue studies for any of the reasons given for the master's candidate; or he may have wished to do fundamental research in a highly interesting and challenging field in which his interest was kindled late in his undergraduate career. Relatively little time is available in undergraduate work for intensive foundry training, and it is necessary for him to continue in order to more fully explore the field. In most cases the degree, per se, is not as important to the student as the interesting time spent in obtaining it; in fact, he is strongly urged to forget that he has the degree.

The doctorate, and to a lesser extent the master's degree, are important to industry and science for another reason. These are the men who pioneer new fields and open new vistas of accomplishment; these are the men who publish scores of articles each year on subjects which would never otherwise come to light.

Some of the greatest advancements in science and industry have come from doctoral researches; the atmosphere and associations, the energy and the creativeness needed for outstanding developments are peculiar to advanced academic study of this sort. The writer has supervised the research of doctorate candidates and of men with doctors' degrees paid specifically to do research in ideally equipped laboratories; there is some quality inherent in the former which spurs him to do an outstanding job in a short time.

In the four years of the foundry training program at M.I.T. five doctor of science men have been graduated. Their theses are:

"Flowability of Foundry Sand."
"Fundamental Studies on Spheroidal Graphite Iron."
"Thermal Distribution in Centrifugal Copper Castings."
"Mold-Metal Interface Reactions."
"Porosity in Cast Copper and Copper Alloys."

Six candidates are in process this year whose research subjects are:

"Porosity in Non-Ferrous Castings."
"Hot Tear Formation in Steel Castings."
"Bonding Action of Core Oils."
"Mechanism of Solidification of Spheroidal Graphite Iron."
"Fundamentals of Packing of Molding Sand."
"Fundamental Studies on Spheroidal Graphite Iron."

So far, all M.I.T. candidates have been absorbed by some branch of the foundry industry, and we have every reason to believe this will continue to be the case. The salaries of the men graduated to date range from $4500.00 to $6600.00 per year. This compares favorably with the salaries of doctorate men in other categories of chemical engineering, mechanical engineering, and metallurgy.

For emphasis, we will be more specific about why graduate study in foundry engineering is important:

(1) Extra years of planned study for the master's and doctor's degrees represent more training, maturity, and breadth of knowledge than can be obtained in the four years for the bachelor's degree. The undergraduate program is a particular variety of general education, based on science. Specialization is possible at the graduate level.

(2) During post-graduate work the student is able to operate more freely and to obtain more individualized instruction. There is also more freedom to make plant visits, attend special seminars and, in short to get the "feel" of the foundry industry.

(3) If a bachelor's training is of any value in developing men more able to solve problems, then added years of mental gymnastics and training in scientific principles and reasoning are sure to make a better man for any given field.

(4) The results of post-graduate research are valuable in proportion to the amount done. To generalize for a moment, industry would surely miss the millions of men who have proved to be leaders without formal education. No one doubts the real importance of these men to industry, nor the ability of a man to forge ahead on his own as a so-called "self-made man." But often these same men wish they could have had the benefits of more "book learning."

(5) It is surely easier to infuse a college-trained man (yes, even a doctor) with the practical things he needs to know than to teach science to a man who may not have continued beyond the high school level.

(6) Most teachers, in the crowded classrooms of today, do not get to know each undergraduate well; they do, however, get to know the graduate student because there are fewer men in his category and the teachers have more time to really get acquainted. The teacher has a better chance to assess the aptitudes of the individual and help him develop his special interests.

(7) For most men technological advancement stops when formal training ends; so it pays to get all the formal education possible while opportunity permits.

Foundry Fertile Research Field

Large oil companies spend millions annually on research in their own and college laboratories; similar research might be of use in foundry practice:

(1) Coke supplies are rapidly diminishing, are decreasing in quality, and coke is becoming increasingly expensive. Sooner or later a natural or synthetic substitute will be needed. Research which has found a substitute for the silkworm and the rubber tree can, if encouraged, help solve this problem.

(2) Removal of sulphur and phosphorus from iron is becoming increasingly essential. This is a problem for the chemist, thermodynamicist, and metallurgist.

(3) Relatively little fundamental knowledge has been developed to alter the age-old custom of pounding sand. Behavior of sand grains under pressures of

various types must be known before the job can be done with greatest efficiency.

(4) Too many casting imperfections are not "an act of God." They occur because of a lack of knowledge to control or prevent them.

(5) Engineers do not have enough convincing data to design castings properly for service performance, economy, and ease of manufacture.

(6) Not all the research is needed in the technical field. Business research in time and motion analysis, foundry cost accounting, labor relations, and materials handling is also sorely needed.

(7) We have been blessed by nature with abundant raw materials, and are rapidly running out of many natural resources. Someone must find substitutes.

The examples are almost endless. Who is to do this research? Few foundries are in a position to attempt it, and it is even difficult to get many foundries to sponsor research in someone else's laboratory. The trade and technical foundry associations are sponsoring more and more research and this is a healthy trend. But the bulk of this work will be done for many years to come by the colleges and universities—by masters and doctorate men.

If post-graduate men are so valuable, why does the potential foundry employer not beat a path to their door? There are several reasons:

(1) There is an erroneous opinion that men with advanced degrees are too rich for the industry's blood. Of course the foundry must meet the "going rate" to tempt good men from going into other fields, or must offer special incentives such as opportunity of advancement. Since the average age of administrative personnel in the foundry industry is well above 50 years, the wideawake foundryman is in good position to compete; anyway the post-graduate engineer will not cost more than a top-notch non-college man after ten or more years of service.

(2) Some think: "You can tell a Ph.D., but you can't tell him much." It is easy to remember the exception and forget the average. A trained scientist is surely no harder to deal with than many self-made men. Most are remarkably accommodating. Some scientists are not fitted for production work, but a little care will get the right man and a little common sense will put him squarely on the team.

(3) Perhaps the greatest deterrent is that the foundryman is not convinced his future is best insured by hiring extra-well-trained men. Only time will prove this to many doubting foundrymen unless the example of other industries is more universally appreciated.

(4) Many foundrymen still think their profession comprises a God-given art. Many old-timers are indeed artists who will find no peer—but times change and modern productivity requirements, marginal profits, and closer tolerances militate against artistry.

Many forces are at work to accelerate the assimilation of college-trained men, at all levels, into the foundry industry. The Foundry Educational Foundation and affiliates have done a marvellous job to bring the trained engineer and the foundryman together. Individual foundrymen are becoming keenly interested, and more and more of them are visiting schools and inquiring for men well in advance of graduation. This

A general view of the crucible furnace reported in the thesis "Design and Development of an Oxygen-City Gas Furnace for Metal Melting" written by James M. Barrabee as partial requirement for a B.S. degree at M.I.T. A condensed version of the thesis was published in AMERICAN FOUNDRYMAN, *December, 1949, p. 51.*

is a healthy sign, for this is how large organizations have recruited men for many years.

A third post-graduate degree, newly instituted at M.I.T., is designed to fill industry's need for men with advanced training for production rather than research or teaching. This is the "Engineers" degree; the student takes subjects in several fields of engineering and does not do a lengthy thesis. In essence he does not need to prove his proficiency for high-level research. This saves the student about a year's work; it actually gives him more and broader training in engineering subjects than he can get in a master's degree, and less research than required for a doctorate.

Conclusion

In conclusion, engineering training at M.I.T. is not directed narrowly toward preparation for particular industries, but seeks, rather, to lay a broad foundation in general education and in the scientific and technical fundamentals of broad professional fields. Thus, there is no "foundry course" in the sense of a four year curriculum in this subject. However, four year curricula in metallurgy, mechanical engineering, and in business and engineering administration permit inclusion of specialized work in the subjects listed above related to foundry practice.

This arrangment provides greater versatility and scope than would be possible in a single, so-called foundry course. The work of the first year and much of the second consists of basic subjects common to all fields of specialization. No student is committed to a program of foundry training before the beginning of his fourth year; all such training is at the fourth and graduate year levels.

If M.I.T. and other institutions are fair examples, colleges and universities are convinced of the desirability of training engineers for the foundry industry —the student is surely interested—and all that remains is for the foundry industry to continue, and to multiply, its demand, and to utilize the engineer to his fullest potentialities.

THREE CENTURIES OF CAST IRON METALLURGY

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Liége, Belgium

On the occasion of the fourth centenary of its Vennes plant, our company has conducted research on the evolution of castings of past centuries.* We summarize here, by means of silicon-carbon diagrams, the results of this research.

The structure curves adopted in some of the diagrams have been traced according to data obtained from ancient castings which we have been able to examine under the microscope. To simplify the report, phosphorus has not been taken into consideration in preparing these diagrams, but we have shown the eutectic line corresponding to the average content of phosphorus in all of our samples of ancient castings, that is, 0.9 per cent.

Figure 1 shows that the silicon and total carbon contents of all the ancient castings, with the two exceptions, are situated in a zone extending from 3.3 to 4.4 per cent total carbon, and from 0.4 to 1.7 per cent silicon. This zone can be compared with the two zones of modern castings which are outlined on this diagram.

Castings made by the ancient foundrymen are quite different from the ordinary modern castings, mainly due to higher carbon and lower silicon contents. The iron was made in cold blast charcoal furnaces, whereas modern irons are made in hot blast coke furnaces, and the metal then re-melted in the cupola or other furnace.

At the end of the Middle Ages blast furnaces appeared, but their weak bellows and small dimensions did not permit them to attain very high temperatures. The carbon-silicon reaction was then limited, and due to low silicon contents the metal had a strong tendency to be white.

Unfortunately, it is impossible to distinguish with certainty castings from that long-past epoch. To be able to follow the evolution of ancient castings, it is necessary to examine the firebacks and stove plates of the 16th century. These often show dates, armorial bearings or ornamental motifs which make it possible to date them.

An examination of Fig. 1 does not disclose any classification among those ancient castings. Analyses of castings of the different epochs are very much mixed up due to the appearance in this diagram of parts from various countries where the evolution of the technical processes had not been identical, parts of different thicknesses, and parts cast directly from the blast furnace or from remelted iron.

In order to understand the evolution of the ancient castings, we are going to follow it through parts of certain date, of average thickness (0.4 to 0.8 in.) and cast in three neighboring countries where the metallurgical processes have evolved in about the same manner—Belgium, the Grand Duchy of Luxembourg, and France.

Approximately 50 castings made in Belgium and Luxembourg from about the year 1500 to and including the 19th century, and 11 castings made in France from 1584 to 1738, comprised the comparative groups. In addition, 16th century castings from Great Britain, and 18 castings made in Germany from 1547 to 1738 were analyzed.

In examining the silicon and total carbon contents of the Belgian, Luxembourg, and French parts of average thickness cast in the 16th century and during the

*Robert Doat, "400-Year Old Belgian Foundry," American Foundryman, Sept. 1950, p. 57.

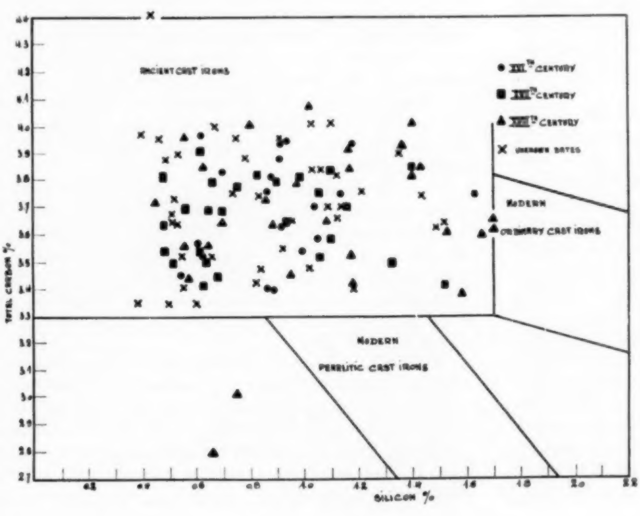

Fig. 1—Silicon and carbon contents of 16th, 17th, and 18th century castings made in cold blast charcoal furnaces range from 3.3 to 4.4 total carbon, and 0.4 to 1.7 per cent silicon. For comparison, the diagram includes the carbon-silicon zones for modern cast irons.

first three quarters of the 17th century, it is apparent that the foundrymen of that epoch were already casting these in mottled and even slightly gray iron, but they still were working quite close to white iron. With a small decrease in blast furnace temperature or in casting section size the castings solidified white.

There was certainly opportunity to note that an increase in the amount of charcoal or prolonged holding of the metal in contact with the fuel in the furnace could make the white casting become mottled, and the mottled casting become gray, as indicated by the solid lines in arrows 1 and 2 of Fig. 2. Experience also will have shown them that beyond certain limits these same means no longer increased the gray tendency of the casting, as indicated by the dotted parts of arrows 1, 2, and 3. However, they must have observed that the more they increased the quantities of charcoal, the more the fluidity of the metal improved, at least up to a certain limit, which is the eutectic line.

Finally, the foundrymen of that period, who certainly were making an effort to avoid the white, hard and fragile casting, did not fail to notice that increasing the furnace blast gave them a grayer casting, since the hotter process gives more silicon. The result of this increase in silicon content is marked in Fig. 2 by arrow 4. The direction of arrow 5 indicates the development of the best foundrymen, who knew how to combine a judicious increase of fuel and blast, and who thus definitely got away from the white casting, at least for parts of average and greater thickness.

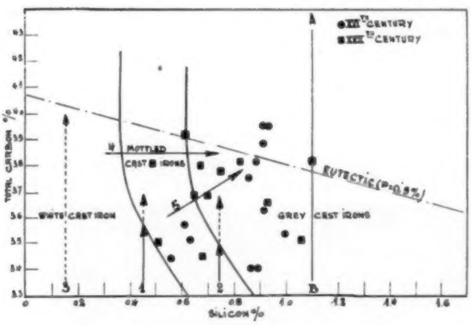

Fig. 2—Silicon-carbon diagram of the ordinary castings made in Belgium, Luxembourg, and France during the 16th and the first 75 years of the 17 centuries.

Certain foundrymen of the 17th century tried to counteract the tendency toward white iron by reducing the cooling rate of the castings. The French savant, Reaumur, writes that the castings were poured in heated molds, or were removed from the mold upon solidification and placed in heated furnaces, where they cooled slowly. In any case, the line AB on Fig. 2 shows the maximum silicon content used by the best Belgian, Luxembourg, and French foundrymen in gray iron castings of average thickness in the 16th century and during the first three quarters of the 17th century.

At the end of the 17th century, the European countries needed large quantities of castings on account of the wars and the great works of the reign of Louis XIV. Foundrymen made an effort to further increase the capacities of the blast furnaces, and improved the ore roasting processes. They utilized more reactive charcoals and stronger fluxes, and extended the zone of the blast furnace in which the reduction of the ore is effected, either by increasing the dimensions of the furnace, or modifying the direction of the tuyeres. Capacities of blowers were also increased. The majority of these innovations resulted in further increasing the operating temperature of the furnaces, and consequently the silicon content and the graphitization of the castings.

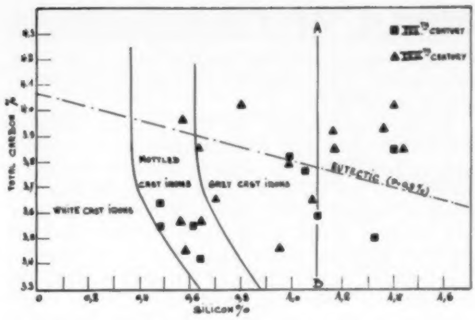

Fig. 3—Castings made at the end of the 17th century and through the 18th century had increased silicon over the preceding period (Fig. 2), and essentially the same carbon content. The line "AB" denotes the maximum silicon content obtained in the preceding period.

Figure 3 shows the carbon and silicon analyses of average thickness castings at the end of the 17th century through the 18th century. The silicon content has increased notably, whereas the carbon content has remained essentially the same. The line AB (approximate maximum silicon content of castings of the preceding period) is considerably exceeded.

At the beginning of the 18th century the foundrymen making parts of average thickness were protected from the danger of the white castings by the increased silicon contents of the iron. But they encountered another danger—that of too gray or even black castings because, with the silicon contents then attained, the castings were hyper-eutectic and of poor quality for parts subject to strains. Throughout the 18th century they tried to find a remedy for this situation.

Had Excessive Graphite

In 1722, Reaumur considered the gray castings as "impure" and advised against their use. No doubt he had observed the effects of the excess graphite in the too gray or black castings. He recommended that white iron only be used, and the castings improved by malleabilization. Four years later, having pursued his research, he decided that gray iron could be used in the foundry and that, when it was too gray, it could be improved by re-melting in the crucible or in various cupolas small and large. He gives descriptions of cupolas which operated with charcoal, bringing the black iron back to the eutectic. In the 18th century, the authors'

plant was oxidizing the excess graphite by again passing the iron through the reverberatory furnace. Other Belgian foundrymen loaded the blast furnace with iron scrap as well as ore, and thus reduced the graphitization of the iron.

In the second half of the 18th century, Grignon, a French foundryman and manufacturer of cannons who utilized high blast furnaces and ores containing graphitizing agents, invented, to combat the graphite, a sort of charcoal cupola. In this he remelted his iron, first breaking it into small pieces. He thus produced an "iron Regulus," which was a sort of cast steel.

Finally, in the last years of the 18th century, the Englishman, Wilkinson, in order to avoid excess graphite in the metal, invented a blast furnace of slight height, but provided with several tuyeres. In this furnace the metal remained for a shorter time and

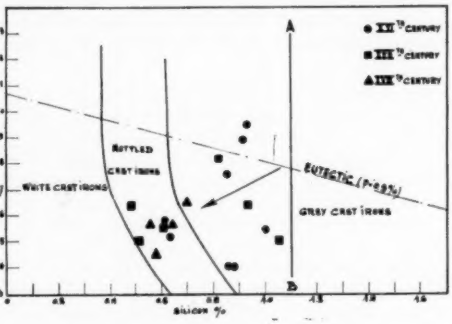

Fig. 4—Diagram showing carbon and silicon of 16th, 17th and 18th century castings made in Luxembourg. The 18th century castings, of smelted iron, are closer to the white iron zone than those of the 16th century.

therefore had less tendency to graphitize. These last two inventions did not become popular.

The process of casting metal into molds became much more important upon the development of coke and the hot blast, which made higher melting temperatures possible. The silicon contents of the iron rose suddenly from 1.7 per cent to 2 or 3 per cent or more. When this occurred cupola melting became general.

Certain analyses in the various diagrams indicate a slower development than that described so far. For example, some irons of the 18th century contain less silicon than certain 16th century irons.

In those days, as at present, there were foundrymen who did not keep abreast of the times. But there is another reason for this dispersion of the analyses in the diagrams—they include irons made for casting and irons which were intended to be refined by the "Walloon" method. This refining process consisted of exposing the end of a piece of pig to the oxidizing action of the flame produced by a blower tuyere in a charcoal smelting hearth; the pig melted drop by drop and the iron, low in silicon and carbon, formed a spongy mass at the bottom of the hearth, which was then hammered to weld the grains of metal and expel the slag.

For several of the ancient dated castings it has been possible to determine definitely that they were made from iron destined for further treatment. These are the ones from Luxembourg, which produced only such iron, but where the furnace masters at times cast an occasional part with their customary metal. Silicon and carbon contents (Fig. 4) of these castings made from Luxembourg smelted irons show that the process had not developed in the same manner as the irons made primarily for casting into molds.

Revert to White Iron

In fact, Fig. 4 shows that the Luxemburgian castings of the 18th century (represented by triangles) form a group closer to the white castings than those of the 16th century (represented by circles). This shows a retreat toward the white castings (see arrow). Moreover, the smelted iron castings of the 17th century (represented by squares) are divided equally between the two tendencies, which confirms that it was in the 17th century that the Luxembourg smelting furnace masters returned to the metal of their ancestors.

This evolution, the reverse of that of the foundrymen, is easily explained. From the 14th century to the 17th century, foundrymen and smelters utilized the same metal. But the foundrymen were interested in producing gray iron castings, and the smelters were interested in having the least possible carbon and silicon to oxidize in the pig iron. In the 17th century, when they observed that the smelting of gray iron was longer and more costly than that of the white, they separated from the foundrymen and turned back to the white iron, primarily by cooler furnace operation.

Those who had not developed as the best foundrymen were not necessarily behind the times—they may have been smelting furnace masters who knew their business well and were interested in developing in the contrary direction.

Summary

In summary, the Belgian, Luxemburgian, and French foundrymen who had developed to the greatest extent were casting parts of average thickness in white iron in the 14th and 15th centuries, in mottled or slightly gray iron in the 16th century and the first three quarters of the 17th century, and in gray or even excessively graphitic iron at the end of the 17th century and throughout the 18th century. In the 18th century they were re-melting at times the blast furnace iron in order to improve it. At the beginning of the 19th century, the appearance of coke and hot air brought about a great excess of graphite in the blast furnace iron, which made the second melting of the metal indispensable.

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FRENCH FOUNDERS HOLD ANNUAL MEET IN PARIS

REPRESENTATIVES OF EIGHT NATIONS attended the 24th Foundry Congress of the French Foundry Technical Association in Paris, June 2 through 6. Present were foundrymen from the United States, Belgium, Great Britain, Italy, Norway, The Netherlands, Switzerland and Turkey, comprising some 10 per cent of the total attendance of 275 foundrymen, it is reported by R. Delpuech of the French Foundry Technical Association staff.

The 24th Congress opened with an informal get-together reception on Saturday, June 2. Sunday was devoted to guided tours of the abbeys of St. Denis and Royaumont and of Chantilly and Senlis castles.

Opening session on Monday, June 4, dealt with the casting of nodular irons, zinc corrosion and application of dilatometric analysis to enameling techniques. At this session M. J. Drachman of A.B. Centrifugalor, Stockholm, presented the Swedish Exchange Paper, in which he described studies correlating chemical analysis and mechanical properties of castings. Presiding at the session was Director Bellier of the French government's mechanical and electrical industries administrative department.

Afternoon's session, with Marcel Ballay of the French Nickel Information Center presiding, was devoted to molding sand research, and determination of the amount of magnesium in ferrous castings.

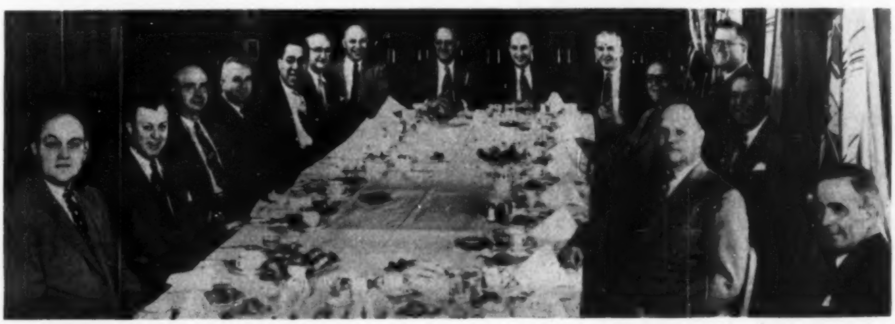
Tuesday morning's session featured three papers on copper alloy castings, and papers on dimensional tolerances and solidification shrinkages.

Afternoon session opened with papers on aluminum alloy castings, followed by presentation of the Official A.F.S. Exchange Paper, *"Mechanizing Medium-Sized Gray Iron Foundries,"* by Henry W. Zimnawoda, National Engineering Co., Chicago. Other session papers dealt with recirculating ovens and the use of chaplets in a pig iron foundry.

Final technical sessions of the Congress, on Wednesday morning, June 6, were given over to such varied topics as castings, grinding, foundry management, and the Official British Exchange Paper on the formation of professional foundry societies in Great Britain, presented by Vincent C. Faulkner of England's *Foundry Trade Journal.*

Association President Daniel Waeles, presented the Grand Medal of Honor to Albert LeThomas, director general of the French Foundry Technical Center, and awarded gold, silver and bronze medals to other French foundrymen for outstanding contributions to the metal casting art.

Committee Plans 1952 International Foundry Congress Exhibits



Meeting June 15 at the Congress Hotel, Chicago, to plan for the 1952 International Foundry Congress & Show in Atlantic City next May 1 through 7, when A.F.S. will be host to the world's foundrymen, were members of the A.F.S. Exhibits Committee, composed of representatives from all branches of the foundry equipment and supply industries. Clockwise from left: Raymond P. Wiggers, Frank G. Hough Co.; A.F.S. Convention and Exhibits Manager A. A. Hilbron; G. R. Meyers, Core Oil Div., Penola, Inc.; R. G. Kaveny, Herman Pneumatic Machine Co., Pittsburgh; FEMA Executive Secretary Arthur J. Tuscany; Walter Bonsack, Christiansen Corp., Chicago; A.F.S. Technical Director S. C. Massari; A.F.S. National President Walter L. Seelbach; FEMA President C. V. Nass, Beardsley & Piper Div., Pettibone Mulliken Corp.; A.F.S. National Secretary-Treasurer Wm. W. Maloney; L. L. Andrus, American Wheelabrator & Equipment Corp.; V. F. Stine, Pangborn Corp.; William L. Hartley, Link-Belt Co.; R. L. McIlvaine, National Engineering Co.; and A.F.S. National Vice-President I. R. Wagner. Present but not shown in photograph were S. H. Hammond, Whiting Corp.; J. A. Jeffrey, Jeffrey Mfg. Co.; F. B. Flynn, S. Obermayer Co.; L. H. Heyl, Federal Foundry Supply Co.; and Russ Matthews, Bakelite Div., Union Carbide & Carbon Corp. Absent was A. J. Grindle of NPA's Foundry Equipment & Supplies Section.

PHOSPHORIC ACID INTERFERENCE WITH QUANTITATIVE IRON PRECIPITATION BY AMMONIUM HYDROXIDE

George Norwitz* and Sidney Tudor
Material Laboratory
New York Naval Shipyard
Brooklyn, N. Y.

Lundell and Hoffman[1] have pointed out that iron salts are partially soluble under the conditions used for the precipitation of magnesium as magnesium ammonium phosphate. It would seem from this that phosphoric acid would hinder the precipitation of iron by ammonium hydroxide. Yet, none of the standard works on quantitative analysis list phosphoric acid or phosphates as interferences in the ammoniacal precipitation of iron, although they all list pyrophosphate. In view of this the authors decided to conduct an investigation on the effect of phosphoric acid on the precipitation of iron by ammonium hydroxide, using varying amounts of iron, phosphoric acid and ammonium hydroxide.

Experimental: A standard ferric chloride solution was prepared as follows. A 2.0000-gram sample of pure electrolytic iron was dissolved in 50 ml of hydrochloric acid (1:1), hydrogen peroxide was added to oxidize the iron, and the excess hydrogen peroxide destroyed by boiling. The solution was cooled and diluted to one liter in a volumetric flask.

Aliquots of the standard iron solution were pipetted into 400-ml beakers, and varying amounts of phosphoric acid (85 per cent) added. The solutions were diluted to 200 ml with water, and were treated with 5 ml of hydrochloric acid (37 per cent) and 5 grams of ammonium chloride. The solutions were neutralized with ammonium hydroxide (28 per cent) using litmus paper as an indicator, and a measured excess of ammonium hydroxide added.

Excess Additions Made

A one ml excess of ammonium hydroxide was added to one series of solutions, and a 15 ml excess to another series. The solutions were heated to boiling, and boiled for one min. The solutions were filtered and the precipitates washed with warm one per cent ammonium chloride solution that had been made just ammoniacal to methyl red.

The precipitates were dissolved back into the original beakers with 30 ml of hot hydrochloric acid (1:1), and the papers washed with hot water. The solutions were then evaporated to a volume of about 15 ml. The iron was reduced with stannous chloride, mercuric chloride was added, and the iron titrated with ceric sulphate using orthophenanthroline indicator.[2] A 0.1N ceric sulphate solution was used to titrate the series containing 0.1 gram of iron, and a 0.02N ceric sulphate solution was used to titrate the series containing 0.01 gram of iron. The results obtained for iron are shown in Table I.

The conclusions to be drawn from the results obtained are:

1. Phosphoric acid can definitely interfere with the precipitation of iron by ammonium hydroxide.
2. The more phosphoric acid and ammonium hydroxide present the greater will be the interference.
3. Up to 1.5 ml of phosphoric acid will do no harm, if only 1 ml of excess ammonium hydroxide is present.

Acknowledgment

The authors wish to thank W. L. Miller for his helpful suggestions.

References

1. G. E. F. Lundell and J. I. Hoffman, *Outlines of Methods of Chemical Analysis*, p. 70, John Wiley and Sons, New York, 1938.
2. W. W. Scott, *Standard Methods of Chemical Analysis*, vol. I, p. 474, D. Van Nostrand Co., New York, 1939.

Table I—Interference of Phosphoric Acid With the Quantitative Precipitation of Iron by Ammonium Hydroxide

Phosphoric Acid (85%), ml	Fe Added, gram	Fe Found, gram
1 ml Excess Ammonium Hydroxide		
0.0	0.1000	0.0996
0.1	0.1000	0.0994
0.3	0.1000	0.0996
0.8	0.1000	0.0992
1.0	0.1000	0.0988
1.3	0.1000	0.0988
1.5	0.1000	0.0989
3.0	0.1000	0.0986
4.0	0.1000	0.0976
10.0	0.1000	0.0969
15.0	0.1000	0.0959
0.0	0.0100	0.0102
0.1	0.0100	0.0098
0.3	0.0100	0.0097
0.8	0.0100	0.0097
1.5	0.0100	0.0098
4.0	0.0100	0.0095
6.0	0.0100	0.0067
8.0	0.0100	0.0080
10.0	0.0100	0.0072
15.0	0.0100	0.0056
15 ml Excess Ammonium Hydroxide		
0.0	0.1000	0.1000
0.1	0.1000	0.0989
0.3	0.1000	0.0894
0.8	0.1000	0.0109
1.5	0.1000	No precipitate
4.0	0.1000	No precipitate
0.0	0.0100	0.0102
0.1	0.0100	0.0077
0.3	0.0100	0.0027
0.8	0.0103	0.0010
1.5	0.0100	No precipitate
2.0	0.0100	No precipitate

* Present address, 3353 Ridge Ave., Philadelphia, Pa.

Note: The opinions expressed in this article are those of the authors, and are not to be construed as representing the official views of the Navy Department.

LETTERS TO THE EDITOR

Sand and Metal Shrinkage

In *"Gray Iron Shrinkage Related to Molding Sand Conditions"* (AMERICAN FOUNDRYMAN, Feb. 1951, pp. 49-55), C. A. Sanders and C. C. Sigerfoos describe work carried out to determine the influence of molding materials which affect the distortion of the mold cavity by the solidifying casting. Their basic thesis is best described by a quotation from an earlier paper by H. L. Womochel and C. C. Sigerfoos (*"Influence of the Mold on Shrinkage in Ferrous Castings,"* A.F.S. TRANSACTIONS, vol. 48, pp. 591-622).

"During solidification, gray iron passes through a highly plastic state. It would appear that the solid metal in a partially solidified casting behaves as a plastic membrane which follows any movement of the mold wall occurring as a result of the action of high temperature and ferrostatic pressure on the sand. Resulting volume changes are fed by molten metal from the riser. In the absence of liquid iron in a riser, shrink cavities are formed, or sinking of the cope face of the casting occurs." (Paragraph 58).

Actual attempts to measure the movement of the mold walls by these investigators are said to have given non-reproducible results.

Again, in describing some of their early results, the same investigators say:

"These results show the relation between piping and swelling. In the case of a very soft mold, swelling evidently continues for some time after pouring has ceased and the casting has partially solidified. The volume occupied by swelling is fed by piping or 'shrinkage'." (Paragraph 11).

Quite clearly, from these excerpts, the authors have in mind that the solid shell of a casting may expand while the center is still liquid and that the properties of the mold materials can exert a profound influence on the extent of this swelling. If such swelling occurs in a casting with a continuous, solid skin, then clearly it can only do so at the expense of forming a cavity in the interior. If the skin is not continuous, i.e., there is an area which is still liquid such as the top of a feeder head, then liquid will feed from this area causing piping.

What is not so clear is what forces act to distend the casting skin. The authors mention ferrostatic pressure but, if the casting has a continuous solid skin, the atmosphere acts with a uniform pressure at all points to oppose swelling of the casting, and this pressure is equal to something like 50 in. ferrostatic pressure. If the skin is not continuous then the atmospheric pressure is balanced on the inside and the outside of the casting walls and only the ferrostatic pressure remains, but in this case feeding will occur from the region where the atmospheric pressure acts on the liquid surface and a pipe will result. It is not possible to see how an internal cavity could arise by this mechanism.

There are still other forces to be considered. The rigidity of the casting skin and the resistance of the mold to compression both oppose swelling of the casting. It must not be assumed that the mold hardness after pouring is the same as that of the mold as rammed, since a soft mold will certainly be compacted by the filling of the mold with liquid metal, resulting in dilation of the mold cavity. Furthermore, gases evolved from the sand may add to the atmospheric pressure acting on the casting surface if the sand permeability is low. Finally, gases evolved from the metal during solidification will tend to aid any tendency of the casting skin to swell providing the gases have no outlet to the atmosphere. All these factors will affect the issue to an unpredictable extent.

Unfortunately the nature of the experiments described in both papers does not appear to lead to results capable of rational interpretation. In the recent paper no measurements of the castings are given and there is no means of deciding whether or not the mold cavities have, in fact, dilated. The conclusions are based solely on the appearances of arbitrary diametral sections of the 2 in. diameter 2 in. high risers. The castings themselves, which are 3 in. in diameter and 4 in. high, were apparently not sectioned. This must surely be an oversight; it is hardly credible that a riser of this size could be expected completely to feed the casting.

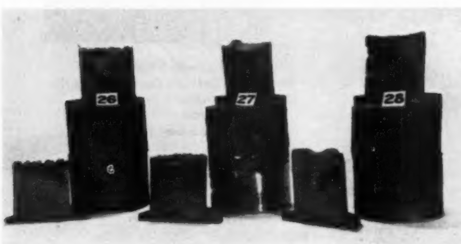
Admittedly the form of the pipe in the riser will depend on feeding of metal from the riser to the casting in the early stages of solidification but the connection between the riser and the casting will be sealed before the center of the casting has solidified. Furthermore, heat loss by radiation from the open riser top is an indeterminate variable which may have a profound influence on the form of the pipe in the riser (compare the pipes in the Sanders-Sigerfoos illustrations Group J and Group K.)

Altogether, the authors do not seem justified in drawing any conclusions from these experiments without very careful analysis of their fundamental concepts and checking of the experiments to ensure that the results are quantitatively reproducible. It would be preferable to design more fruitful experiments.

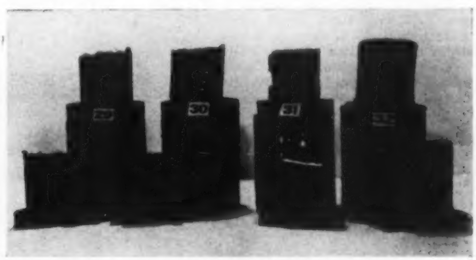
Much the same criticisms can be made of the experimental work described in the earlier paper. The measurements given in Table I of this paper prove nothing at all since dilation of the mold cavity could easily occur during filling of the mold with liquid metal. In this connection it is pertinent to ask whether the calculation made by E. J. Ash in the subsequent discussion is of any real value.

It is quite conceivable that the original conception of mold cavity dilation may be a factor of considerable importance in the formation of pipes and draws. If the investigators had designed experiments which would lead to more conclusive results they would have contributed materially to our understanding of shrinkage problems which is of vital interest to the foundry industry.

J. E. SRAWLEY
British Cast Iron Research Assoc.
Alvechurch, England



Group J



Group K

Sigerfoos' Reply

The fundamental theory as advanced in the papers being criticized by Mr. Srawley is briefly that apparent shrinkage ("draw down" or "riser pipe") of gray iron is caused in part by the dilation of the sand mold cavity immediately after pouring.

In criticizing the recent paper by Sanders

(Continued on Page 83)

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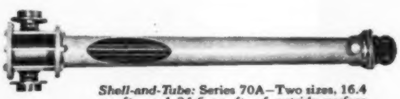

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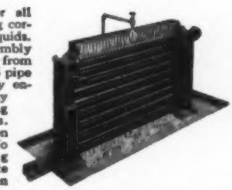

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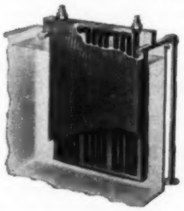

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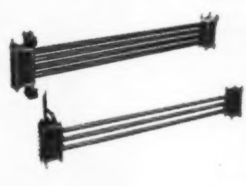

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FOUNDRY lities

Clair Crawford has been appointed field sales manager of Frederic B. Stevens, Inc.'s Foundry Supply Dept., it is announced by President W. J. Cluff. During his several years with Stevens, Mr. Crawford has specialized in the development and application of foundry facings and has visited

Clair Crawford

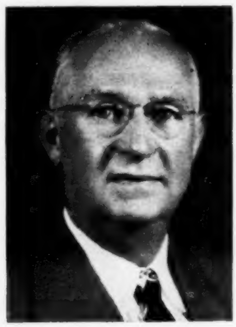
foundries throughout Canada and the United States. He is a member of the A.F.S. Detroit Chapter and American Welding Society.

Walter W. Edens, formerly of Badger Brass & Aluminum Co., Milwaukee, has joined Alloy Engineering & Casting Co., Champaign, Ill., as associate director of its Casting Potentials Project, which is based on a contract between the company and the Air Force's Air Materials Command. Purpose of the Project is to improve and modify existing techniques to produce high integrity castings for aircraft and armaments, and to broaden understanding of casting design for aircraft and missiles. Mr. Edens is immediate past president of the A.F.S. Wisconsin Chapter.

Don M. McCutcheon, metallurgical engineer for Ford Motor Co., Dearborn, Mich., has been named manager of the physics department of Ford's new scientific laboratory. A Ford employee since 1935, Mr. McCutcheon for several years directed activities of its Applied Physics Unit. Among projects Mr. McCutcheon has directed is development of a successful isotope gage for automatic determination of liquid metal height in foundry cupolas.

Harry A. Schwartz, who has represented A.F.S. since 1928 on Committee A-7 of the American Society for Testing Materials, has asked to be relieved of his assignment and has been replaced by A.F.S. Past National President **Hyman Bornstein.**

Thomas E. Akers has been elected president and **Maurice N. Trainer** chairman of the Board of Directors of Dominion Brake Shoe Co., Ltd., Canadian subsidiary of the American Brake Shoe Co. At the same time, **Kenneth T. Fawcett** was named vice-president of Brake Shoe's American



T. E. Akers

Brakeblok and Kellogg divisions. Mr. Akers was formerly vice-president of Dominion Brake Shoe and during his career with Brake Shoe since 1902 has been vice-president of its Ramapo Ajax and Canadian Ramapo divisions. New Board Chairman Maurice N. Trainer is president of American Brake Shoe Co. and was former-

M. N. Trainer

ly president of Canadian Brake Shoe. He first joined Brake Shoe in 1916 as an inspector. Canadian-born Kenneth T. Fawcett joined Brake Shoe in 1934 as an apprentice following graduation from Yale University. He has since been general purchasing agent and Dominion vice-president since 1947. He will continue to serve in that position and as vice-president of American Brakeblok and Kellogg divisions.

G. O. Loach has been elected a director and vice-president of Electro Metallurgical Co. of Canada, Ltd. Mr. Loach has been engaged in sales and technical service activities for the company since 1945, during which his work brought him into contact with all major foundries and steel

G. O. Loach

mills in Canada. He is a member of A.F.S., AIMME and the Association of Professional Engineers.

Lloyd Canfield of Lloyd Canfield Founddry Supplies, Kansas City, Kansas, has been appointed a representative for the Foundry Products Division, Archer-Daniels-Midland Co. Mr. Canfield attended the University of Kansas City before going into the foundry business with his father. After three years as a Navy pilot, he formed his own foundry supply and equipment company in 1948. He is membership chairman and a director of the A.F.S. Mo-Kan Chapter.

Palmer E. Hanson has been named sales field engineer for the Machine Division of Osborn Mfg. Co., Cleveland. He will make his headquarters in Milwaukee and will cover Northern Indiana, Northern Illinois, Iowa, Wisconsin and Minnesota. Mr. Hanson was formerly plant manager for Federal Malleable Co., West Allis, Wis., and was at one time in charge of sales and engineering of Rockwell Mfg. Co.'s Arcade Division.

Alfred Iddles, president of the Babcock & Wilcox Co., New York, was awarded an honorary degree of doctor of engineering by Polytechnic Institute of Brooklyn at its 96th Commencement, June 13. Mr. Iddles was cited as a "constructive and creative engineer, competent and wise administrator and master of the details and operations of a large enterprise."

J. A. Rumpsa has left Caterpillar Tractor Co., Peoria, Ill., to become foundry manager of Ordill Foundry & Manufacturing Co., Herrin, Ill., effective July 1. The foundry produces gray iron castings for electrical fittings and small and medium machinery castings.

Robert F. Galvin has been named president and chief executive officer of the Ohio Steel Foundry Co., Lima, Ohio.

Thomas W. Seaton, formerly sand and service engineer with Beardsley & Piper Div., Pettibone Mulliken Corp., Chicago, has joined America Silica Sand Co., Ottawa, Ill., as sales engineer. He is a graduate of the University of Illinois and was for a time with Allis-Chalmers Mfg. Co.

Clyde Williams, director of Battelle Memorial Institute, Columbus, Ohio, received a doctor of science degree from Ohio State University during its June commencement exercises for "great contributions to science and industry, a high concept of citizenship, and leadership."

Andrew Kavosi has been appointed foundry superintendent and **Leslie Jones** works manager of Auto Specialties Mfg. Co. (Canada) Ltd., Windsor, Ont. Mr. Kavosi was core room foreman at Auto Specialties for 13 years and assistant foundry superintendent for one year. Mr. Jones has been with the company for 20 years in various capacities.

Franklin L. Fickett, formerly of Fairbanks, Morse & Co., has been named sales engineer in Indiana, Ohio and Michigan for Hunt-Spiller Mfg. Corp., Boston.

William T. McGinnis has been named assistant to the president and **L. W. Coquillette** assistant to the vice-president of Keokuk Electro Metals Co., Keokuk, Iowa. Before joining Keokuk, Mr. McGinnis was manager and vice-president of Pacific Northwest Alloys, Inc., Spokane, Wash., and served as a major during World War II. Mr. Coquillette was formerly manager of the Keokuk office of McGladrey, Hansen and Dunn and Co., accounting firm, and served as a bomber pilot in the air force in the war, flying 50 combat missions. Re-elected by Keokuk's Board of Directors were President **G. L. Weissenburger,** Vice-President **J. W. Miller,** Vice-President and Secretary **Edward H. Fries,** Vice-President in Charge of Operations **L. E. Othmer** and Assistant Secretary and Treasurer **C. W. Hiserote.**

Karl E. Baker, formerly foundry foreman for National Radiator Co., New Castle, Pa., has been named assistant manager of Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich. He was also for several years foreman and assistant superintendent at Chicago Pneumatic Tool Co., Franklin, Pa.

Eugene M. Stein, research metallurgist for Gunite Foundries Corp., Rockford, Ill., has joined Battelle Memorial Institute's metallurgical research staff.

B. Emmet Hartnett, Chicago metallurgical engineer and onetime president of the Hartnett Foundry Co. in that city, has been named deputy director for the Office of Price Stabilization's Chicago office.

(Continued on Page 71)

THIS MONTH'S AUTHORS

H. H. Fairfield and **F. W. Kellam,** co-authors of *"Casting Surface: Volume Ratio Predicts Gray Iron Properties,"* Page 30, are chief metallurgist for William Kennedy & Sons, Owen Sound, Ont., and metallurgical engineer for Electro Metallurgical Co. of Canada, Welland, Ont., respectively. Mr. Fairfield, who was formerly foundry consultant to the Harry W. Dietert Co., Detroit, has been active on the Sand Division's Committee 8-J and has spoken on various phases of foundry work at several A.F.S. Conventions, as well as contributing frequently to the trade and technical press. His co-author, F. W. Kellogg, was also with William Kennedy & Sons, as metallurgist, until this April, when he joined Electro Metallurgical Co. of Canada. Holder of a B. Sc. from the University of Toronto, Mr. Kellam saw service as a lieutenant of Royal Canadian Engineers in World War II.

Robert Doat, author *"Three Centuries of Cast Iron Metallurgy,"* Page 58, is management engineer for Belgium's Compagnie Generale des Conduites d'Eau, Liege, reputed to be Europe's oldest foundry. A graduate of the University of Liege, he also instructs metallurgy classes at the Gramme Institute, Leige. Mr. Doat has spoken frequently before foundry groups both in Belgium and abroad and attended the 1950 A.F.S. Foundry Congress in Cleveland as official representative of the Belgian Foundry Technical Society.

Howard F. Taylor, author of *"Graduate Studies for the Foundry,"* Page 54, has long been prominent in the field of foundry education. In addition to his work as associate professor of metallurgy at the Massachusetts Institute of Technology, he has been active in educational work for both A.F.S. and the Foundry Educational Foundation, has been instrumental in developing the New England Regional Foundry Conferences at MIT, and is chairman of the A.F.S. Fluidity Testing Committee. Mr. Taylor, whose career includes teaching at his alma mater, Michigan State College, and work on the staff of the Naval Research Laboratory, was awarded the first A.F.S. Peter L. Simpson Gold Medal at the 1946 A.F.S. Convention.

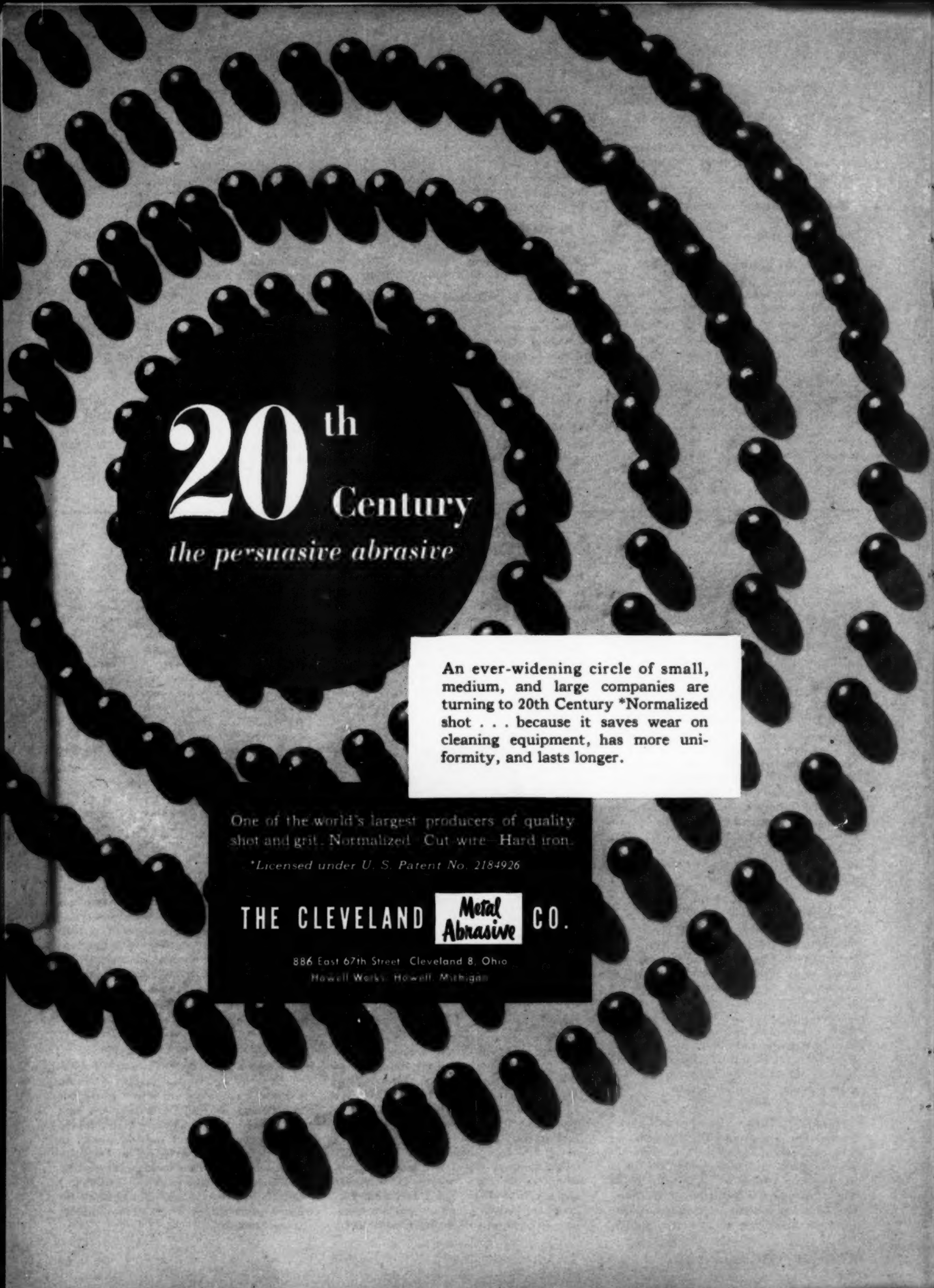
W. C. Jeffrey

Warren C. Jeffrey, author of *"Zirconium Alloy as Manganese Substitute in Gray Cast Iron,"* Page 46, is metallurgist for the Production Foundries Division of Jackson Industries, Inc., Birmingham, Ala. Mr. Jeffrey attended both Georgia Tech and the University of Alabama, graduating from the latter institution in 1947. During World War II, Mr. Jeffrey served first as an inspector for the Army's Ordnance Department, and later as a lieutenant in the 87th Infantry Division. He is active in both the A.F.S. and ASM Birmingham District Chapters, and is a member of the latter's Executive Committee.

John R. Walley, who authored *"Incentive for Difficult-to-Measure Foundry Operations,"* Page 36, is foundry specialist with the management consulting firm of Helmick & Associates, Canton, Ohio. Since attending the University of Cincinnati and Miami (Ohio) University, Mr. Walley has been a time study and methods analyst, personnel director and superintendent of standards in several Ohio foundries. During World War II, Mr. Walley served as a Training Within Industry instructor, teaching in Dayton area plants. He has written several articles on personnel work and time study for the trade press.

George Norwitz and **Sidney Tudor,** co-authors of *"Phosphoric Acid Interference with Quantitative Iron Precipitation by Ammonium Hydroxide,"* Page 62, developed material for this article while at New York Naval Shipyard's Materials Laboratory, Brooklyn. Mr. Norwitz, who is no longer with the Laboratory, has collaborated with other members of its staff on several articles dealing with development of chemical analysis methods, which have appeared in recent issues of AMERICAN FOUNDRYMAN. A graduate of Temple University, Mr. Norwitz has been a chemist at both the Philadelphia and New York Naval Shipyards.

Thomas L. Harsell, Jr., author of *"Foundry Joins in Developing Cupola Emission Control Unit,"* Page 42, is in business for himself at Los Angeles as a fume and dust control consultant. A graduate of the Missouri School of Mines and Metallurgy in 1939, he has since served as an executive engineer in West Coast smelting and chemical companies and prior to becoming a consultant was a chemical engineer for Los Angeles County's Gray Iron Foundry Smog Committee.



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the persuasive abrasive
An ever-widening circle of small, medium, and large companies are turning to 20th Century *Normalized shot . . . because it saves wear on cleaning equipment, has more uniformity, and lasts longer.
One of the world's largest producers of quality shot and grit. Normalized Cut-wire—Hard iron.
*Licensed under U. S. Patent No. 2184926
THE CLEVELAND Metal Abrasive CO.
886 East 67th Street Cleveland 8, Ohio
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PERSONALITIES

(Continued from Page 69)

L. L. Andrus, formerly vice-president in charge of sales of American Wheelabrator & Equipment Co., Mishawaka, Ind., is newly promoted to vice-president and executive head of the Dust & Fume Division. Other new executive appointments include those of **John A. Silver**, to be director of sales; and **E. B. Rich**, Chicago representative, to be general sales manager. **A. E. Lenhard**, advertising and sales promotion manager, will also take on market research and sales development work. Sales Man-

(Continued on Page 89)

L. L. Andrus

J. A. Silver

E. B. Rich

A. F. S. CHAPTER DIRECTORY

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WISCONSIN CHAPTER *Secretary*, Albert F. Pfeiffer, 1610 S. 78th St., West Allis 14, Wis.

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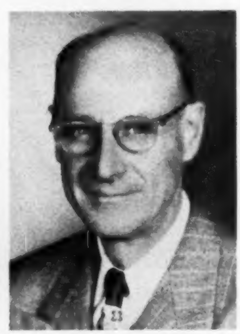
Rochester Gas & Electric Corp.
Rochester, N. Y.
Vice-Chairman
Rochester Chapter

R. G. Wagner
Dependable Foundry Co.
Spokane, Wash.
Director
Washington Chapter



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Toledo Chapter

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Mexico, D. F., Mexico
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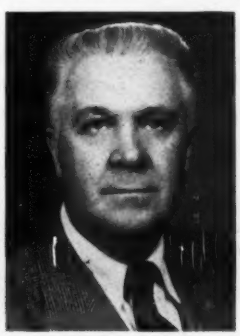
Mexico City Chapter

Albert E. Edwards
Chevrolet Grey Iron Fdy., GMC
Saginaw, Mich.
Chairman
Saginaw Valley Chapter



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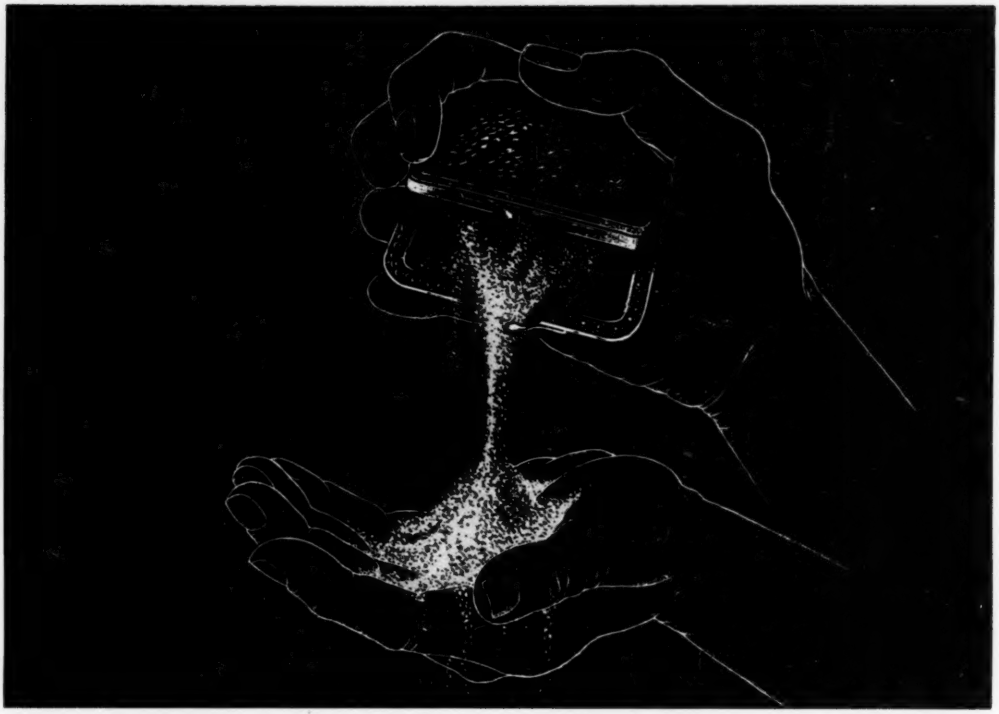
Chairman
Timberline Chapter

Wm. Ferrell
Auto Specialties Mfg. Co.
St. Joseph, Mich.
Director
Michiana Chapter



Renewal of old acquaintances, good chow and barnyard golf were among many attractions at Western *New York Chapter's Annual Picnic, held on June 23. (Photo: John R. Wark, Wark Foundry Services, Inc.)*

CHAPTER ACTIVITIES NEWS

Oregon

Norman E. Hall
Electric Steel Foundry Co.
Chapter Reporter

FINAL BUSINESS MEETING of the season was held at the Heathman Hotel, Portland, May 21, and featured election of officers for the coming year. They are:

Chairman, E. J. Hyche, Rich Mfg. Co.; *vice-chairman*, William M. Halverson, Electric Steel Castings Co.; *secretary-treasurer*, M. O. Woodall, Rich Mfg. Co.; *directors*—Harold Luick, National Lead Co., Magnus Metal Div.; J. T. Dorigan, Electric Steel Castings Co.; and M. O. Woodall, Rich Mfg. Co.

Retiring Secretary (now vice-chairman) William M. Halverson reported on the Chapter's financial status for the year, and Retiring Chairman James Brodigan received an auto radio from Retiring Director George E. Vann, Northwest Foundry & Furniture Co., on behalf of the Chapter for his successful term of office.

John Peterson upheld Electric Steel Castings Co.'s winning streak by holding the lucky number in the A.F.S. Building Fund drawing.

Following the business meeting was a showing of the A.F.S. sound-color research film, *"Fluid Flow in Transparent Molds—II."*

Snapped at the final 1950-51 meeting of the Southern California Chapter by Chapter Photographer Kenneth Sheckler of Calmo Engineering Co. were, left to right: Incoming Chapter President Henry Howell, Howell Foundry Co.; Speaker Robert C. Stone of the Federal Bureau of Investigation; and Retiring Chapter President John Wilson, Climax Molybdenum Company.

Northern California

J. M. Snyder
Jos. Musto Sons
Keenan Co., Abrasive Division
Publicity Chairman

LAST REGULAR MEETING of the season was held in the Hotel Shattuck's University Room Berkeley, on May 18. Lawrence D. Pridmore, International Molding Machine Co., La Grange Park, Ill., spoke on the *"Fundamentals of Core Blowing."*

Mr. Pridmore explained the proper venting of coreboxes and told of new improvements in coreblowing. Cores from several foundries throughout the country were on display and blackboard illustrations were used by Mr. Pridmore to emphasize his discussion. The speaker answered many questions on individual problems put to him by his audience.

A standing round of applause was accorded Retiring Chapter President John Russo of Russo Foundry Equipment Co. for his excellent work as

president and for the marked increase in membership and meeting attendance shown during his term of office.

Entertainment Chairman Edwin Brumley of Brumley-Donaldson Co. directed plans for the Chapter's Annual Ladies' Night June 15 at the Sequoyah Country Club. He was assisted by Clayton D. Russell of Phoenix Iron Works, co-chairman for the event.

A record turnout of 90 foundrymen and their ladies enjoyed an excellent dinner and dancing.

During the evening, Incoming President Philip C. Rodger of General Metals Corp. presented Outgoing President John Russo with an automatic coffeemaker on behalf of the Chapter.

Central Illinois

Robert J. Paluska
Caterpillar Tractor Co.
Chapter Reporter

SOME 300 MEMBERS and their guests attended the Chapter's Fifth Annual Clambake, held June 9 at the Veterans of Foreign Wars Clubhouse at Morton, Ill.

Golf blind bogey and horseshoe pitching occupied most of the members' time in the early afternoon. Golf balls and golfing accessories were given as prizes.

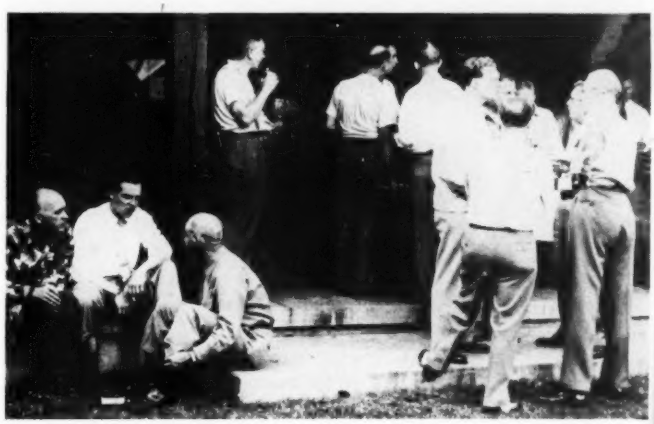
The weather being favorable, the clams and chickens were steamed over an open wood fire and served outdoors. It was a very enjoyable day and Chapter members are looking forward to next year's Clambake.

Northwestern Pennsylvania

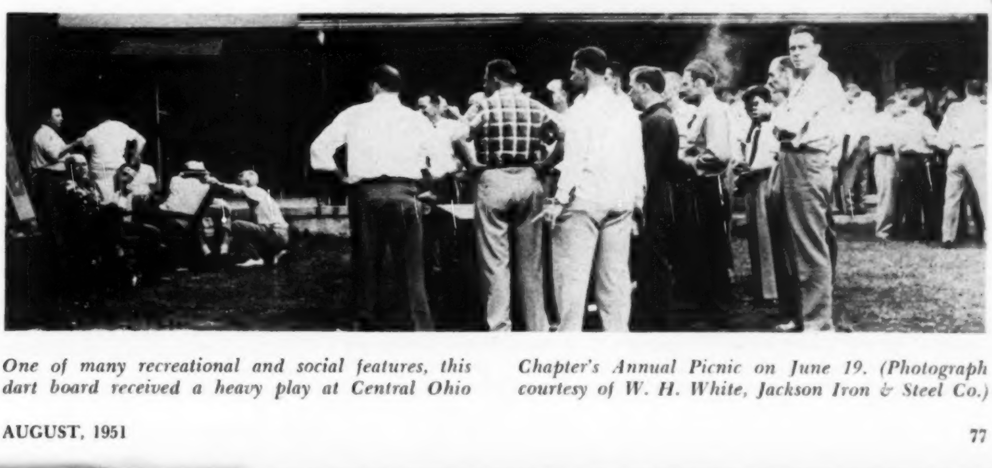
Earl M. Strick
Erie Malleable Iron Co.
Past Chairman

BEST ATTENDED MEETING of the year saw 175 members and guests assembled in the Moose Club, Erie, for Top Management Night. Members and city, county and industrial leaders heard three speakers—Mayor Pulling

Chapter Director J. M. Snyder, National Grinding Wheel Sales, measures a hypothetical grinding wheel under the critical eye of Frank Blake, Carborundum Co., left, and James Allen of Pacific Abrasive Supply Co. in a pre-dinner shoptalk fest at a Northern California Chapter meeting.



Loafin' in the sun was an attraction of Central Ohio's Picnic, June 16.



One of many recreational and social features, this dart board received a heavy play at Central Ohio Chapter's Annual Picnic on June 19. (Photograph courtesy of W. H. White, Jackson Iron & Steel Co.)

About 300 foundrymen attended Ontario Chapter's Annual Meeting and Entertainment. Evening's features were a social hour, dinner, entertainment, election of officers. (Photo: J. Richardson, Wm. R. Barnes, Ltd.)

Lucky winner of a drill set in Oregon Chapter's A.F.S. Building Fund drawing was John Peterson of Electric Steel Foundry Co., Portland. Smiling congratulations at right is William Halverson of Electric Steel.

Good chow and plenty of it, as evidenced by this groaning table, was the keynote of Central Illinois Chapter's Annual Clambake, held June 9 at Morton, Ill. (Photo courtesy Fred Brosmer, Caterpillar Tractor Co.)

of Erie, A.F.S. National Vice-President (now President) Walter L. Seelbach, and Frank G. Steinebach, Penton Publishing Co., Cleveland.

Opening the meeting, Mayor Pulling stressed the importance of the foundry industry to the city of Erie, which, he said, owes much of its growth and prosperity to the foundries, which have grown in number from one small furnace in 1833 to 27 in the immediate area today.

A.F.S. President Seelbach spoke on the advantages of the Society to its members, to the foundry industry, and to the nation during today's national emergency.

Speaking on "*What's Ahead,*" Frank G. Steinebach cited several instances wherein directives by government agencies not acquainted with foundry problems have caused confusion. Only because of the work of various foundry committees is this confusion being held to a minimum, he said, adding that since World War II, all foundry societies and associations have worked together to make sure that the foundry industry is not left out on a limb as it was in the 1940's.

Retiring Chairman Frank Volgstadt, Griswold Mfg. Co., thanked Chapter officers, directors, committeemen and members for their loyal support and cited particularly the work of Earl M. Strick of Erie Malleable Iron Co., who retired as secretary this year after serving successively as a director, vice-chairman and chairman of the Chapter since its organization six years ago.

Elected to office for 1951-52 are: *chairman*, Douglas C. James, Cooper-Bessemer Corp., Grove City, Pa.; *vice-chairman*, Fred Carlson, Weil-McLain Co., Erie; *treasurer*, Clyde Cooper, Keystone Brass Co., Erie; and *secretary*, Bailey D. Herrington, Hickman, Williams & Co., Inc., Erie.

New directors, all of Erie, are: Frank Volgstadt, Griswold Mfg. Co.; Roy A. Loder, Erie Malleable Iron Co.; Jacob Diemert, Erie Castings Co.; Theodore Fritts, National Erie Co.; and David Fourspring, Read Standard Corp.

Following election and introduction of new officers, 1951-52 Chairman Douglas C. James took over and presented Carl Vaupel of Cooper-Bessemer Corp., who in turn acted as toastmaster and introduced A.F.S. National Directors T. E. Eagan of Cooper-Bessemer and Martin J. O'Brien, Jr., Symington Gould Corp., Depew, N. Y.

Past chairman Earl M. Strick presented past chairmen's pins to Joseph Shuffstall and Frank Volgstadt and congratulated both on their successful terms of office.

The Chapter again voted to hold its

meetings on the fourth Monday of each month, beginning in September, at the Moose Club, Erie.

Southern California

S. L. Jackson
Electro Metallurgical Co.
A Division of Union Carbide & Carbon Corp.
Publicity Chairman

CONCLUDING MEETING of the season, held at Los Angeles' Rodger Young Auditorium June 8, had as its speaker Robert C. Stone of the Federal Bureau of Investigation, who discussed *"Plant Protection and Sabotage."*

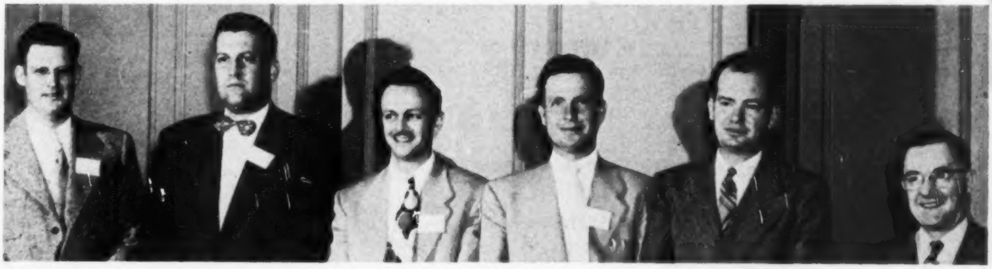
Mr. Stone described many methods which saboteurs use to effect slow-down and, in some instances, complete collapse of production. He emphasized the importance of vigilance by foundry management to eliminate the theft of both tools and materials from the foundries. Such activity is one of the most nefarious forms of sabotage. To offset the aims of those whose purposes are to disrupt and destroy American production, he said management must properly screen all employees, both old and new, recognize the departments of the foundry which are strategic, and be prepared to obviate the actions of the enemy.

Prior to Mr. Stone's talk, John Wilson, retiring Chapter president, presented cash prizes to the winners of the molding contest. The first prize was taken by Ramon Rosas and second prize by Ray Orr, both of Howell Foundry Co. The third prize was won by Glenn Mack, a student at Manual Arts High School. After an acknowledgment of the duties performed by his staff during the current year's activities, Mr. Wilson installed new President Henry Howell of Howell Foundry Co. and introduced new officers and Board of Directors.

All Past Presidents were honored by the Chapter, which invited them to be guests at the meeting. Those who

Southern California Chapter Past Presidents were well represented at the Chapter's June 8 meeting. Standing, left to right, are: William Emmett, Los Angeles Steel Casting Co.; H. E. Russill, Eld Metal Co., Ltd.; Earle D. Shomaker, Kay Brunner Steel Products Co.; W. D. Bailey, Jr., Westlectric Castings, Inc.; and Earl Anderson, Enterprise Iron Works. Seated from left W. F. Haggman, Haggman Foundry Supply Co.; Past National Director Robert Gregg, Reliance Regulator Div., American Meter Corp.; Al Zima, International Nickel Co.; and James Eppley, Axelson Manufacturing Co. (Photo by Kenneth Sheckler, Calmo Engineering).

Social hour opened Ontario Chapter's Annual Meeting and Entertainment.



Oregon Chapter officers, past, present and future, posed for Photographer Norman Hall, Electric Steel Foundry Co. at the June 21 meeting. From left, New Director J. T. Dorigan, Electric Steel Foundry Co.; Continuing Director William M. Halverson, also of Electric Steel; Retiring President James T. Brodigan, Columbia Steel Casting Co.; Incoming President E. J. Hyche, Rich Mfg. Co.; Retiring Director George C. Vann, Northwest Foundry & Furniture Co.; Continuing Director Henry Weiss, of Mobilift Corp.

CHAPTER ACTIVITIES

attended made up a sizable table. Henry E. Russill of Eld Metal Co., Ltd. introduced the past presidents, each of whom offered his best wishes to the officers during the coming year. Those present besides Mr. Russill were: W. D. Bailey, Jr., Westlectric Castings, Inc.; William D. Emmett, Los Angeles Steel Casting Co.; James E. Epply, Axelson Manufacturing Co.; W. F. Haggman, Haggman Foundry Supply; Robert Gregg, Reliance Regulator Div., American Motor Co.; Albert G. Zima, International Nickel Co.; Earl Anderson, Enterprise Iron Works; and Earle Shomaker, Kay Brunner Steel Products Co.

Unable to attend were J. G. Coffman, Robert R. Haley, Leonard O. Hofstetter, and B. G. Emmett.

CHAPTER MEETINGS

• AUGUST 18

CANTON DISTRICT
Mayfair Country Club, Canton
Annual Picnic

WESTERN MICHIGAN
Pontaluna Golf Club, Muskegon
Annual Picnic

• SEPTEMBER 13

ST. LOUIS DISTRICT
York Hotel, St. Louis
Warner B. Bishop
Archer-Daniels-Midland Co.
"Core Binders—Their Characteristics and Use"

• SEPTEMBER 17

QUAD CITY
Ft. Armstrong Hotel, Rock Island, Ill.
Clyde A. Sanders
American Colloid Co.
"Is It Possible for the Molder to Create Apparent Metal Shrinkage?"

• SEPTEMBER 21

CHESAPEAKE
Chambersburg, Pa.
C. D. Galloway
Chambersburg Engineering Co.
"Cement Bonded Sand Molding and Production Operations"
Plant Visitations

• SEPTEMBER 22

TENNESSEE
Chattanooga Golf and County Club
Annual Picnic

MICHIANA
Tabor Farms, Sodus, Mich.
Annual Picnic

NEW Foundry Products

For additional information on New Products, use postcard at bottom of this page.

Metallograph

1—Simple, compact metallograph is complete with every facility for examining, studying and photographing metal samples and other materials. Unit measures 12 x 12 x 18-in. high. Features include complete assortment of high-quality parfocal lenses, vibration-eliminating base, three-speed vertical movement staging table that always centers about optical axis; binoculars with wide range of magnification and adjustments; ground glass viewing screen; preloaded ball-bearing support column; five filters mounted in turret head; and automatically-focused 35mm. 36 frame precision camera. *F. T. Griswold Manufacturing Co.*

Re-Usable Sweatband

2—Expandable cotton, re-usable sweatband retails for price of a disposable band, keeps eyes cool and comfortable, keeps spectacles and goggles clear and provides sanitary protection. Serviceable and simple, these cotton sweatbands are feather-light and super-soft, yet are strong enough to stand repeated rinsings and re-use. No metal parts to rust or chafe. Samples available from *General Scientific Equipment Co.*

Salt Tablet Dispenser

3—Expendable plastic salt tablet dispenser, the Crystal-M, contains 1000 enteric coated salt tablets, visible at all times. Entire unit, including tablets, is sealed at the factory to insure unsoiled tablets throughout the life of the unit. Simplified mechanism requires only slight pressure to release a tablet. Expendable dispenser is easily removed, discarded and replaced with a new one. *Standard Safety Equipment Co.*

Anti-Rust Paint

4—Penetrating and sealing anti-rust paint, PCA-100, can be applied directly over both interior and exterior rusted surfaces, and is equally effective in preventing rust on new metal or stopping rust action on already-rusted metal. Upon application, PCA-100 penetrates through rust layer into base metal and seals surface against further rusting. Paint is suitable for brush or spray application. PCA-100 is furnished in black only and should be used solely as a finish coat. Companion product, PCA-101, a clear paint, can be painted over with any standard paint of any color. *Paint Corp. of America.*

Band Saw Guide

5—New band saw guide, according to manufacturer, has such advantages as (1) holds blade at any angle, (2) has ball-bearing wheels that reduce danger of blade breakage, and (3) holds working portion of blade so that more work can be performed. When 36-in. band saw machines are equipped with these Model 20 guides and the material is held at a 45 degree angle, material can be cut to any length. Guides are easily adjusted to the width, thickness and desired angle of the blade. *Paddock Tool Co.*

Welding Rod

6—Bronze welding rod with an extra-thin tinning action eliminates pre-welding preparations and is covered with a flux coating that yields full-strength joints on old, corroded and dirty cast iron. Tensile strength is listed at up to 55,000 psi, with a Brinell hardness of 75-120. Manufacturer claims this is the first bronze welding rod that can be used in chamfer joints as well as in square butt and lap joint applications. *Eutectic Welding Alloys Corporation.*

(Continued on Page 92)

Reader Service (AUGUST/51)

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FOUNDRY *Literature*

[illegible] information on foundry literature use postcard at bottom of this page.

[illegible]

[illegible] temperature [illegible] before pouring; and [illegible] in galvanizing [illegible]. These and other applications are outlined for Models [illegible] and [illegible]. *Wheelco Instruments Co.*

Foundry Oil and Gas Burners

[illegible]—Catalog [illegible] describes such foundry oil and gas burning equipment as cupola lighters, mold dryers, ladle heaters, core baking and furnace heating equipment. Applications, specifications and operating data are augmented by photographs of typical foundry installations. *Hauck Manufacturing Company.*

Chain Drives and Conveyors

10—Bulletin 51-7 shows how to get the most service from chain drive and conveyor sprocket chains. Text describes proper installation, operation, inspection, lubrication and adjustment, and illustrations show correct and incorrect ways of solving installation, operation and maintenance problems. *Chain Belt Company.*

Air Pollution

11—Reprint of the AMERICAN FOUNDRYMAN article, *"Air Pollution and the Foundry Industry,"* (February, 1951) by John M. Kane, deals with foundry problems introduced by growing emphasis on air pollution abatement and setting up of control standards. Diagrammatically illustrated, the 4-page reprint describes controls attainable with present-day equipment in dust-producing operations, in melting, in non-ferrous foundry work and in cupola operation. Also outlined are air pollution problems in electric furnace and pouring operations and cost of control equipment. *American Air Filter Co.*

Non-Ferrous Alloy Impregnant

12—Bulletin No. 501 gives properties and applications of Armetol, an improved impregnant for magnesium alloy, aluminum bronze and other non-ferrous castings, and stresses nine advantages of Armetol over tung oil and sodium silicate methods, including baking temperature of 275 F, plasticity, low viscosity, and ability to withstand heat, chemical treatment, boiling water, hot oil and gasoline, etc. Information is given on equipment and complete impregnating procedure. *Foundry Products Division, Archer-Daniels-Midland Company.*

Portable Air Tools

13—Catalog 38 illustrates and describes the complete line of Rotor Air Tools, together with application photographs and specifications. Shown are screw drivers, nut setters, sanders, drills, grinders, rammers, chippers and scalers. *Rotor Tool Company.*

Preparing for Atomic Attack

14—30-page illustrated booklet, *"How to Prepare Your Plant for Atomic Attack,"* is designed to help industrial plants of all sizes organize against the possibility of atomic attack and prepare for sustained production in the case of a national emergency.

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LETTERS

(Continued from Page 65)

and Sigerfoos in which the above theory is applied, it is indeed unfortunate that Mr. Srawley apparently overlooked the companion paper by Walter F. Bohm entitled "*Mold Materials as Factors in Gray Iron Shrinkage*" published in the January 1951 issue of AMERICAN FOUNDRYMAN. Mr. Bohm's research at the Buick Foundry leaves no doubt as to relationship between the "draw down" or apparent shrink cavity and the change in the dimensional size of the casting.

Mr. Srawley's expressed skepticism of the theory that a partially solidified shell of gray iron tends to continue expansion against soft rammed or high moisture sands clearly indicates that he has a misconception of the mechanism of gray iron solidification. The irons, of the compositions used in the experiments, do not tend to form the solid shell next to the sand as argued by Mr. Srawley.

Various bleeding experiments carried on here at Michigan State College have shown that the initially formed shell of iron is soft and weak and will often collapse when the liquid is bled from the inside of a casting. The inefficiency of atmospheric risers in gray iron as compared to steel is another indication of the weak condition of this shell of iron. Mr. Srawley's arguments regarding solidification and riser design are obviously more in line with steel casting practice than gray iron.

Criticism based upon scientific facts or experimental evidence would, of course, be readily acceptable and indeed much appreciated by the authors as well as the foundry industry. Mr. Srawley and one or two other recent critics have exhibited no experimental evidence of their own to back up their opinions. In this connection, it is strongly recommended by the writer that critics at least take the time to experiment with a few green and dry sand mixtures. They should simply pour a few ball or stick shaped gray iron specimens in the different sands and note the results.

It is further recommended that a correction be made in the next edition of the A.F.S. book ANALYSIS OF CASTING DEFECTS. The new edition should include molding sand as a possible cause of a "draw down" defect in gray iron. The same correction should also be applied to the various defective casting charts currently being supplied to foundries.

A very important development in this problem of sand vs. apparent shrinkage is the A.F.S.-sponsored research on gray iron risers in progress at the present time under the able leadership of Howard F. Taylor at the Massachusetts Institute of Technology. An interesting review of the progress on this research was presented at the A.F.S. Annual Convention in Buffalo, in April. It is indeed encouraging to note that this interim report was in general agreement with the earlier research and indicated that the type and condition of the mold sand has a profound influence on the apparent shrinkage.

C. C. SIGERFOOS, *Assoc. Prof.*
Mechanical Engineering
Michigan State College

(Continued on following Page)

LETTERS

(Continued from Preceding Page)

Womochel's Reply

I wish to thank Mr. Srawley for his interest in our 1940 paper dealing with the influence of the mold on shrinkage defects in gray iron castings. As co-author of the original paper, I feel justified in replying to some of his criticisms.

The principal purpose of this research was to establish that the mold was a factor in causing piping defects and sinking of the cope face in gray iron castings. A considerable number of carefully controlled experiments are described in this paper which show the effects of such variables as green compression strength, sea coal content, moisture content, type of mold, and mold hardness on the occurrence of these defects. These relations are established for a wide range of metal composition, pouring temperature, and types of sand both natural and synthetic.

Several papers have been published since 1940 which confirm these findings. It is reported in these papers that principles set forth have been of value in helping to eliminate these defects.

A number of experiments were undertaken to determine the mechanism of this effect. An influence on cooling rate was suggested. Experiments in which thermocouples were set in the mold face of various types of molds were made and cooling curves were plotted. These experiments are described in paragraphs 54 and 55 of the Womochel-Sigerfoos paper. No correlation between the shrinkage defects and cooling rates was found.

Experiments in which partially solidified castings were drained of molten metal were conducted in an effort to find some appreciable influence of the mold on solidification rates (paragraphs 51-53). No relation could be established.

Careful studies of the microstructure of the castings were made. No influence on microstructure could be associated with the presence or absence of defects (paragraphs 55-57).

The absence of any influence on the metal structure indicated that the effect was a result of changes in the volume of mold cavity resulting from expansion or contraction of the sand produced by the temperature change, and from ferrostatic pressure. Observation of the molds after pouring leads to this conclusion. A casting in one mold will develop a pipe which sinks steadily for some time after pouring is completed, while the metal level in the riser of another casting from the same ladle but in another type of mold will remain stationary or even rise a little. That the mold is acting to bring about these changes would seem to be an inescapable conclusion.

Measurements were made on castings from the various molds and a correlation between casting dimensions and the piping was found (paragraph 60) indicating that the piping feeds volume changes in the mold or that cavities which would otherwise develop in the casting are kept closed by the expansion of the mold material. In the absence of any detectable effect on the metal we believe that this afforded the best available evidence as to the nature

of the defects. Our findings and conclusions are confirmed by the experiments reported by Mr. Bohm.

An attempt was made to construct a device which would measure the movement of the mold wall in contact with the solidifying metal. These attempts were not successful because of mechanical difficulties. The lack of reproducability mentioned in our paper was a result of these difficulties and not a result of inconsistencies in data obtained. The use of some form of dilatometer might be open to criticism because mold conditions are not reproduced.

Mr. Srawley calls attention to the fact that the dimensional changes described could take place during the pouring of the mold. That these changes start during pouring is to be expected and mention is made (paragraph 60) of the fact that the deeply piped castings are slightly heavier than other castings from the same ladle. That these changes continue for some time after pouring ceases is also to be expected and can be verified by observation of the castings during solidification.

The part played by atmospheric pressure in determining the presence or absence of some of these defects is understood. Most of the defects described in these reports are open pipes where atmospheric pressure is not a factor, or a drawing in of some face of the casting under atmospheric pressure to compensate for volume changes elsewhere in the mold cavity.

Many of the cavities occurring at the base of the riser (Figs. 10, 11 and 12) are connected to the atmosphere apparently by the rupture of the solidifying layer of iron at the casting surface. In the two remaining cases where there is a sizable imperfection at the riser base (Fig. 10 and 16) the possibility exists that access to the atmosphere existed during solidification through an opening or porosity which is not evident in the plane through which the casting was sectioned.

In his discussion, Mr. Srawley makes this statement in referring to the fact that the risers used are smaller than the castings: "It is hardly credible that a riser of this size could be expected completely to feed the casting."

We wish to call attention to the fact that the risers on the large castings of the original paper are much smaller in section than the castings and that gating is into the casting so that the riser was filled with relatively cold metal. Yet many of the castings shown in this report are sound and show very little if any piping in the riser.

If the defects encountered in gray iron castings originated solely from solidification contraction it would not appear possible to produce a sound casting with a small riser. That sound castings can be produced consistently in this way provides us with our best evidence that the presence or absence of these defects in gray iron castings is not determined entirely by solidification contraction of the iron.

It is our hope that in this discussion of the possible causes of this phenomena that the important development will not be forgotten. In our opinion this is that troublesome defects hitherto attributed to

LETTERS

(Continued from Preceding Page)

solidification contraction of the metal can be eliminated by altering mold conditions. That practical foundrymen are taking advantage of this principle to produce better castings is now evident from the literature. In view of this fact we feel compelled to ask if Mr. Srawley is entirely justified in implying in his last sentence that the authors of these papers have not "contributed materially to our understanding of shrinkage problems which are of vital interest to the foundry industry."

H. L. Womochel, *Assoc. Prof.*
Mechanical Engineering
Michigan State College

Sanders' Reply

We have only to read the first page of Mr. Srawley's letter to understand that he is obviously confused regarding certain papers. He is assuming that one paper directly reflects the ideas expressed in the other and each coincides completely. This is in error.

Mr. Srawley is quoting from the earlier paper in order to criticize the recent paper and is dealing entirely with technical opinions rather than the actual facts which prevail regardless of opinions.

To summarize briefly, in green sand molding the molds are considered to be pliable under certain sand conditions and will slowly yield under the pressure and heat of molten iron. It is believed that the static pressure of the liquid iron plus the effect of the migration of the moisture away from the surface of the mold cavity will tend to cause a change in the mold cavity dimensions.

When hot metal is poured into a green sand mold, there are many dimensional changes at the mold-metal interface and any force which exceeds the rigidity of the mold at the mold-metal interface, will cause the mold to move.

If the mold moves and increases in volume, the casting which is formed in the mold will be oversized and overweight. If this casting is not fed properly during the change of this increased area, apparent shrink cavities can occur at various "hot spots" in the casting or can "pull down" in the cope areas particularly near, or in bosses.

Too often we find that in-gates and feeders are frozen before the casting has solidified, if this be so, and if movement of the mold occurs, what will feed the casting during its solidification?

We have done much additional work regarding this subject in production operations and find that many facts bear out this relationship. Theory and investigation are now being studied closely as many machine shops are finding castings that are too-over-sized and in other cases they are finding the casting under-sized and are beginning to wonder just what part molding materials play in determining casting tolerances.

If we have a plastic, green sand mold, what prevents the weight of metal from disturbing this mold-metal surface, when the mold can easily be disturbed by even the pressure of the molder's fingers? We must not overlook this important fact, as we have generally assumed in the past that shrinkage occurs only when metal conditions and metal composition are disturbed. We have given too little attention to the part that ceramic molding materials play in this all too important function.

Clyde A. Sanders, *Vice-Pres.*
American Colloid Co.
Chicago, Ill.

Electric Metal Makers Elect Officers

Elected 1951-52 officers of the Electric Metal Makers Guild at the Guild's Annual Meeting in June were:

President, C. C. Spencer, Electric Steel Casting Co., Indianapolis; *Vice-President*, J. H. Baldrey, Allegheny Ludlum Steel Co., Watervliet, N. Y.; and *Secretary-Treasurer*, C. B. Williams, Massillon Steel Casting Co., Massillon, Ohio.

Begin Work on New X-Ray Process

Xeroradiography, a new process designed to reduce use of films and darkrooms in industrial x-ray work, is being readied for commercial use by a program jointly launched by Battelle Memorial Institute, the Haloid Co., Rochester, N. Y., and the General Electric X-Ray Corp., Milwaukee.

Xeroradiography (pronounced "zeroradiography) is expected to cut cost and speed up x-ray inspection, making it available to small foundries and shops.

ABSTRACTS

Abstracts below have been prepared by RESEARCH INFORMATION SERVICE of The John Crerar Library from current American and foreign literature. For literature searches and translations of technical, industrial, and scientific literature, and photostats and microfilm, write to: Research Information Service, The John Crerar Library, 86 East Randolph Street, Chicago 1, Illinois. Rates for above services given on request.

Ductile Iron Properties

A131—PRODUCTION AND APPLICATIONS. John F. Kahles and Norman Zlatin, "High Machinability and Productivity of Ductile Iron," *Metal Progress*, vol. 59, Feb. 1951, pp. 238-242.

Ductile iron (magnesium-containing cast iron in which the free graphite takes the spheroidal form in the as-cast state), either as-cast or annealed, maintains high physical strength and acquires excellent machinability; three recommended grades are 90-65-2, 80-60-5, and 60-45-15. The microstructure, desirable annealing practices and the results of a number of tool-life tests on this metal are summarized. The potential application of ductile iron in the high-production automotive, tractor, engine, and other fields is outlined.

Casting Heavy Metals

A132—DEFECT SOURCES. E. Tofaute, "The Casting of Heavy Metals," *Giesserei*, vol. 38, March 22, 1951, pp 121-124.

This is a review article describing common sources of faults in the casting of heavy metals, especially copper. The faults described include those resulting from moist molds, coke-fired furnace melting, chills, sulphur-containing molds, insufficient deoxidation, and hydrogen-containing copper. (in German)

Continuous Steel Casting

A133—COPPER MOLD USED. Irving Rossi, "Some Observations on the Continuous Casting of Steel," *Journal of Metals*, vol. 3, March 1951, pp. 227-228.

The author, president of Continuous Metalcast Corp. New York, has worked out continuous casting methods for nonferrous metals (now in production) and steel. The latter methods have been tested recently at the Watervliet plant of Allegheny Ludlum Steel Corp. on a pilot basis. The Rossi mold is copper, rather than brass, and is claimed to be effective in withstanding the erosion and heat of steel. The low thermal conductivity of the steel apparently does not limit the casting rate.

Drying Sand, Molds, Cores

A134—COMPARE METHODS AND EQUIPMENT G. T. Hampton and W. H. Taylor, "Molds and Cores," *Iron and Steel*, vol. 24, April 1951, pp. 117-121.

An account is given of the drying practices used in the foundry industry, illustrated by details of the methods and equipment used in the author's plant (F. H. Lloyd and Co., Ltd). The following

types of drying are included: static and rotary drying for sand, core drying, and stove, hot air and torch drying for molds. A comparison is given of the efficiency of mold stoves, and of core ovens (coal-fired, gas-fired, continuous gas-fired, continuous coke-fired).

Die Casting Surface Finish

A135—Preparation Methods. D. F. Seymour, "Preparing Zinc-Base and Aluminum-Base Die Castings for Finishing," *Materials and Methods*, vol. 33, Mar. 1951, pp. 68-69.

The surface finishes usually imparted to zinc-base and aluminum-base die castings are paint, enamel, or an electroplate. In order to obtain the best results the casting requires special preparation prior to finishing. The author discusses the problem inherent in preparing these materials for finishing, and the author presents a step-by-step description of the methods used.

Gray Iron Melting in Sweden

A136—Raw Material to Molten Iron Controls. Göte Lindgren, "Cupola Melting at Husqvarna and Norrahammar," *Gjuteriet*, vol. 41, Jan. 1951, pp. 1-9.

A general discussion is given of the melting practice and cupola used at two of Sweden's largest gray iron foundries. Some of the points covered are: handling raw materials from storage to furnace; charging equipment; dust suppression; and blowers and air weight control. The control of raw materials, furnace operation and molten iron is covered, and the possibility of measuring iron temperature continuously is mentioned. Specific data on melting rate, coke ratios and blast rate are included.

Foundry Controls

A137—Record Forms and Staff. T. H. Wood, "Production and Methods Control," *Foundry Trade Journal*, vol. 89, No. 1790, Dec. 21, 1950, pp. 529-533.

Brief presentation of production control system applicable to almost any foundry. Production staff is outlined by author who states that unusual increase in paper work and clerical staff is not required. Forms shown and described include: quotation, estimate sheet, master record cards, operation job cards, material control cards, foundry method cards, and master record envelopes. A flow chart shows co-ordination of paper work.

Die Cast Valve Parts

A138—Obtain Smooth Surfaces. "Stop-off Core Gives Production Flexibility," *Die Castings*, vol. 9, May 1951, pp. 27-29.

A new design for a hand control valve is described. Included in the design are four zinc alloy die castings. These are chosen because they are moderate in cost, are readily produced and are fully cored in the shapes required. External surfaces are smooth and need no polishing or other machine work. Zinc alloy is chosen because it combines good strength and high impact resistance with ease of casting.

Electric Furnace Refining

A139—Oxidizing and Deoxidizing Periods. W. Godecke, Metallurgy in a Carbon Arc Melting Furnace," *Giesserei*, vol. 8, April 19, 1951, pp. 169-174.

An investigation of refining in a carbon arc furnace is described. Dephosphorization, desulphurization and decarbonization curves for an oxidizing period are given, and an example is shown of a calculation of loss during a deoxidizing period. The lining material to be used in an arc furnace is also considered, and the use of dolomite as the basic material with such a lining is described.

Low Sulphur Iron

A140—Consistent Results Obtained. S. D. Baumer and P. M. Hulme, "Desulphurizing Molten Iron With Calcium Carbide," *Journal of Metals*, vol. 3, April, 1951, pp. 313-318.

A new process for desulphurizing molten iron is described. It is shown that calcium carbide can be made to desulphurize molten iron either on a batch or a continuous flow operation. When promptly applied, it can consistently extract better than 90 per cent of the sulphur content. About 10 to 12 lb of carbide is required per pound of sulphur removed. The efficiency is independent of both sulphur level and temperature of the metal. The process will drive sulphur content to lower levels more consistently than the conventional treatments, levels of 0.01-0.02 per cent being easily attainable.

PERSONALITIES

(Continued from Page 71)

ager **S. S. Deputy** has been given new executive sales assignments, and **Bernard Lester** will continue as sales management consultant. New director of sales John A. Silver has had 23 years experience in engineering management and was formerly a partner in the firm of Lester and Silver, New York and Philadelphia management sales consultants. General Sales Manager E. B. Rich started in Wheelabrator's foundry in 1934 and became Chicago district manager in 1945. Mr. Andrus as head of the Dust & Fume Division will develop equipment and new markets, and will also handle special assignments for the president. He came to Wheelabrator in 1934 from the consulting engineering firm of Sargent & Lundy.

George W. Cannon, George W. Cannon Co., Muskegon, Mich., recently headed a highly successful campaign to raise funds for expansion of Muskegon's Mercy Hospital. Under Mr. Cannon's general chairmanship, the campaign raised $625,945, well over its original goal of $450,000. Also prominent in the fund-raising drive was **Otto A. Seyferth,** president, West Michigan Steel Casting Co., who served as chairman of the Advanced Gifts division. Muskegon area foundries and their employees were active solicitors and contributed large amounts to the cause.

Frank Wartgow joined Ford Motor Co., Aircraft Engine Div., Chicago, as process engineer in the Foundry Engineering Dept. April 26. Prior to this he was production manager for Howard Foundry Co., Chicago. He was formerly with American Steel Foundries and was a member of the A.F.S. National Office Staff.

E. H. Roper has been appointed manager of Air Reduction Co., Inc.'s general technical sales department. Mr. Roper has been assistant manager of the department since 1948. He is a graduate of Yale University's Sheffield Scientific School.

OBITUARIES

Carl F. Lauenstein, since 1936 chief metallurgist for Link-Belt Co.'s two Indianapolis plants and newly appointed director of research for the company, died in a railroad wreck at Bryn Mawr, Pa., May 19. He was 50 years old. A 1922 graduate of Purdue University, Mr. Lauenstein had been active in the A.F.S. Malleable Division and in the Malleable Founders' Society for several years.

Huntington B. Crouse, Jr., 41, president of Crouse-Hinds Co., Syracuse, N. Y., died May 14. Mr. Crouse, a Phi Beta Kappa, graduated from Princeton University Magna cum laude in a class of 476 men and for a time studied law at Harvard University. He joined Crouse-Hinds as an assistant timestudy man in 1935 and during World War II established the company's priority system for handling war orders. He was elected secretary of the company in 1941, vice-president in 1943, and president in 1948. Mr. Crouse was active in several civic, social and industrial organizations in the Syracuse area.

FOUNDRY FIRM *Facts*

Keokuk Electro Metals Co., Keokuk, Iowa, recently completed a 50 per cent expansion of its production facilities at Rock Island, Wash., and at its Keokuk plant plans to erect an additional furnace, complete its graphite and slag control equipment, and rearrange and modernize its finished materials handling facilities. Estimated cost of the expansion program at both plants is about $1,700,000.

Whiting Corporation, Harvey, Ill., at its annual Board of Directors meeting elected Stevens H. Hammond chairman of the Board and re-elected J. A. Handley vice-president and chief executive officer of the company. Mr. Handley reports that Whiting has the highest backlog in its history, with new orders coming in constantly, and that production will be stepped up materially when Whiting's new assembly shop at Harvey and a new plant at Norwalk, Calif., are completed.

Crouse-Hinds Co., Syracuse, N. Y., announces several new appointments at the top executive level. Company officers elected and re-elected include: William L. Hinds, chairman of the Board; Albert F. Hills, president; W. Cornell Blanding, executive vice-president; John R. Tuttle, vice-president and treasurer; Charles M. Crofoot, honorary commercial vice-president; F. Ware Clary, vice-president in charge of Public Relations and Publicity; Carl H. Bissell, vice-president in charge of Engineering; John G. Hummel, vice-president and general manager; Hamilton Armstrong, vice-president in charge of Plant Operations; Robert J. Sloan, Secretary; Walter F. Beach, controller; Robert J. Jones, assistant to vice-president and office manager; Erle R. Monesmith, vice-president and general sales manager; Russell P. Northrup, commercial vice-president and assistant general sales manager; and Albert H. Clarke, Frank J. Fancher and Kenneth W. Mackall, commercial vice-presidents.

American Brake Shoe Co.'s new Brake Shoe and Castings Division plant at Pomona, Calif., now in the drawing board stage, will feature a highly mechanized sand handling system. Instead of a shakeout pit, sand and castings from the shakeout will go onto a two-deck vibrating conveyor. The top deck will handle castings, chill block and shop scrap, and the bottom deck will carry sand. Shoe castings will be taken from the top deck and hung on a trolley conveyor leading to a blast cleaner. Installation of gratings around molding machines will allow extra sand to fall back onto a spill belt conveyor, to be carried back to storage. Among other sand handling features of the Pomona plant will be use of a concrete silo in place of a steel bin for storing sand, and scrap bin walls made of railroad ties.

Foundry Equipment Manufacturers Expand Facilities

In line with expansion policies to meet increasing demands on production of foundry equipment are these new buildings constructed by suppliers. At top is American Air Filter Co.'s new offices at Louisville. Chief feature of this modern structure, according to company officials, is that it has the cleanest air of any building of its type in the country, due to installation of three types of the company's air filters in series in the air conditioning system. Below is Miller Motor Co.'s new 50,000 sq ft plant at Melrose Park, Ill., for the production of air and hydraulic cylinders. Plant's interior features use of color dynamics and complete visibility between offices and factory.

LITERATURE

(Continued from Page 82)

FOR FURTHER INFORMATION ON FOUNDRY LITERATURE LISTED HERE USE CONVENIENT POSTCARD ON PAGE 82

gency. Information is given on the explosive, heat and radiation effects of the atom bomb, amount of damage to structures at varying distances from center of blast, likeliest enemy targets, how to organize a plant defense system, shelter and building construction, and how to combat resultant fires. Also given are pointers on where to obtain help in defense planning, and a bibliography of articles and books on atomic disaster control. *Walter Kidde & Co., Inc.*

Core Oil Data Sheet

15—Product Data Sheet contains a complete description of baking properties, performance, workability and advantages of Hy-Ten 397, a versatile, compatible core oil that assures a high degree of efficiency in the foundry, regardless of sand, type of metal, core sizes, time cycle or baking conditions, according to manufacturer. *E. F. Houghton & Co.*

Fork Truck Lubrication Chart

16—26-point lubrication chart covers eight Hyster industrial truck models. Folding into a pocket-size handy reference, the chart numbers all service points of the eight models, tells when they should be serviced, and recommends certain types of oils and greases. Equipment charted includes the Turret-Truck Power Unit, models 20, 40, 75 and 150 fork lift trucks, the Karry Krane and M3 and MH3 straddle trucks. *Hyster Co.*

Core Rod Straightener

17—The same core rods and gaggers can be used several times by means of a core rod straightener and shear machine described in Bulletin No. 10-B, which shows specifications and capacities of various models, together with detailed operating data and case histories of cost savings. Mechanical details of the machine are explained and illustrations show its operation. *American Wheelabrator & Equipment Company.*

Foreman Training

18—Paperbound booklet, *"What Foreman Training Means to Production and Profits,"* contains answers to such questions as Why Consider Foreman Training?, How Does Foreman Training Pay for Itself?, What Can Foreman Training Accomplish Today?, Why Should You Consider Engineered Training?, etc. and describes the Knight System of Engineered Training. *Lester B. Knight & Associates, Inc.*

Metallographic Equipment

19—Catalog E-232 contains a detailed description and illustrations of the new Balphot Metallograph. Shown are such advantages as compact operating zone, quick action stage elevator and change of objectives, time saving body change and means for using either dark field, bright field, polarized light or phase contrast. Described are the Magna Viewer, photographic unit and other parts of the Balphot Metallograph. *Bausch & Lomb Optical Company.*

Sand Handling Systems

20—Illustrated 8-page Bulletin No. 204 shows typical installations and applications of New Way Foundry Sand Handling Systems. Equipment described and illustrated includes aerators, conveyor belts, core crushers and core drawing machines, line markers, mills and sand conditioning units, mold conveyors, rotary plate feeders, sand gates, and handling systems and turntables. *Newaygo Engineering Company.*

Electric Furnace Melting Data

21—Data sheet for melters contains suggestions on how to reduce electrode costs in such fundamental electric arc furnace operations as melting, tapping and pouring, oxidation and de-oxidation. Also given are precautions for electrode use and a method of calculating the amount of pig iron needed to raise carbon content in the melt, and of calculating chrome or other alloy additions. *International Graphite & Electrode Corp.*

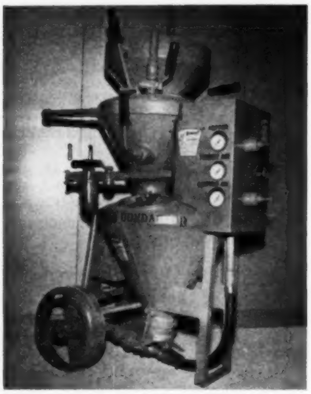
NEW PRODUCTS

(Continued from Page 81)

FOR FURTHER INFORMATION ON NEW FOUNDRY PRODUCTS LISTED HERE USE CONVENIENT POSTCARD ON PAGE 81.

Refractory Gun

22—Completely redesigned, the new Bondact machine accomplishes air placement of refractory patching materials, ramming them into position by air pressure —a process especially effective in lining and patching cupolas, open and mixing



ladles. A large hopper provides greater refractory capacity, while improved pressure control insures more exact control of moisture content of the patch, resulting in a more durable lining. Also new are grouped control panel and heavier construction throughout the machine. *Eastern Clay Products, Inc.*

Spindle Sander and Grinder

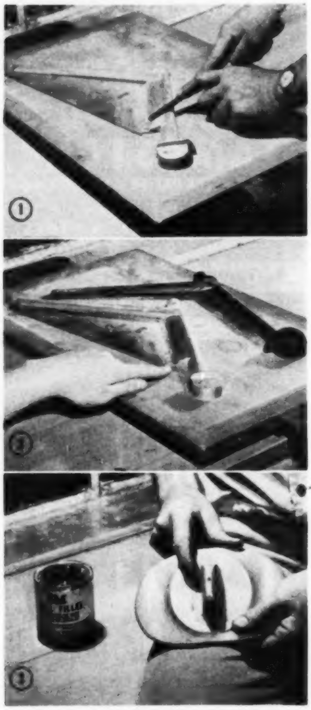
23—Tilting spindle instead of a tilting table, a feature of the Master spindle sander, insures that work is always in a

horizontal position. Unit can be tilted from 0 to 45 degrees by a worm and gear unit, locked in place in any desired position, and can be used oscillating or non-oscillating. Exclusive core box attachment

feature produces straight and tapered core boxes mechanically. Other features include: lighted periscope for reading settings accurately; a 2 hp constant motor with choice of 2000 and 4000 rpm speeds; abrasive sleeves adaptable to diameters of $\frac{1}{4}$ to 4 in. and 6 to 11 in. lengths, and to grinding wheels up to 5 in. diameter x 5 in. high. Built-in safety device prevents use of high speed with large-diameter units. *Kindt-Collins Company.*

Metal Pattern Filler

24—Last-minute modifications in metal production patterns, eliminating the need for making a complete new pattern, are made possible by 3M Metal Filler—a metal putty made from aluminum powder. Applied in 1/32 in. to $\frac{1}{4}$ in. layers, filler



is used to build up already mounted patterns to the contour desired. Drying time ranges from 40 min. to 24 hr, depending on thickness of the layers. Greater thicknesses are built up by applying successive layers, allowing each to dry thoroughly. Metal filler is built up slightly higher than desired, then sanded down to a featheredge when dry. No heating or tinning is necessary. Filler can be used on both metal and wood patterns and, where strength is not a major requirement, to fill sand and blow holes on finished castings. As shown in the photo strip (1) filler is either filed or sanded to shape and will not chip, crack or peel away; (2) triangle fillet is added to a production pattern without removing it from board—original

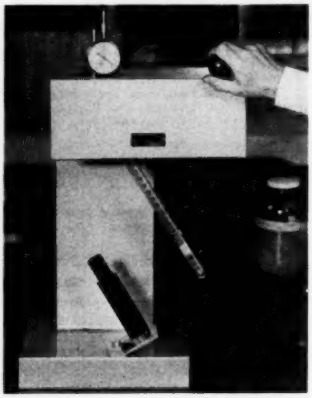
NEW PRODUCTS

FOR FURTHER INFORMATION ON NEW FOUNDRY PRODUCTS LISTED HERE USE CONVENIENT POSTCARD ON PAGE 81.

wood pattern, without fillet is at top right for comparison; and (3) metal filler is applied to a mast plate pattern to "beef up" points at which stress will be greater than first anticipated—this may be done by hand or with a putty knife or squeegee. *Minnesota Mining & Mfg. Co.*

Impact Tester

25—Impact tester determines impact strength of molding sands and of baked cores. Tester has heavy steel supporting frame mounted on swinging impact arm, pivoted on ball-bearings to give a low



windage loss with percussion center in the middle of the impact striker. Specimen is held at 60 degree angle with horizontal plane to give minimum throw energy. Will test A.F.S. Standard 2 x 2 in., A.F.S. Tentative Standard 1⅛ x 2 in., and suggested ¾ x 2 in. molding sand test specimens. For baked cores, either the A.F.S. Standard Tensile Briquett or A.F.S. Standard Transverse Bar may be used. Impact strength value is read from a dial indicator in inch-pounds impact per sq in. of section. *Harry W. Dietert Co.*

Spring-Mounted Shakeout

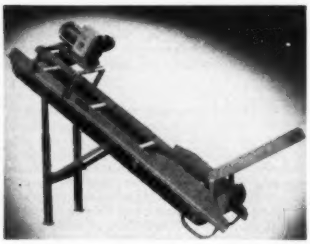
26—Spring-mounted shakeout gives more live action in core knockout and

shaking sand from cores and castings through use of piston-type corner snubbers

and unique shaft design that control vertical vibration and concentrate it at the deck, reducing vibration in the supporting structure to a minimum. Positive vertical vibration control prevents casting travel toward one end of the deck—a dangerous hazard if the flask or casting slips its chains. Shakeouts are available in a wide range of larger sizes for use as single or multiple units. *Simplicity Engineering Co.*

Semi-Stationary Conveyor

27—Little Hustler semi-stationary conveyor is not bolted down and can be readily moved to conform with changes in working areas or plant layout. Of welded



steel, unit handles small castings, borings, turnings, chips, etc., economically and is useful as an auxiliary unit to a high-production permanent conveyor system. Series S conveyors are available in five lengths, with belts 12, 18 or 24 in. wide. In the 4 ft size, the discharge end can be raised from a minimum of 27½ in. to a maximum of 37 in.; in the 6 ft size, from 37 to 57 in.; 8 ft length, from 40 to 70 in.; 10 ft length, from 48 to 87 in.; and 12 ft length, from 56 to 96 in. Conveyor features positive trap and charging chute and for operations in congested areas, special swivel charging chute can be attached to the Series S conveyor. *May-Fran Engineering.*

Fork Truck Clamp

28—Hydraulically operated industrial fork truck clamp enables bins, bales, drums and miscellaneous containers to be picked up and transported on the center-

line of the truck. When used with a rotator, clamp does not creep off center. Loss of pressure grip of arms is minimized and variable clamping pressure permits handling of any type of load. Self-centering arms have an inside opening range from 17 in. minimum to 66 in. maximum. Clamp will handle loads up to 6,000 lb and can be installed on gasoline or electric trucks. *Yale & Towne Mfg. Co.*

Index to Advertisers

A. F. S. Employment Service

To contact "Help Wanted" or "Position Wanted" advertisers, write to American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5, designating item number and issue of AMERICAN FOUNDRYMAN in which advertisement is published.

HELP WANTED

HW566—Chief Inspector: in malleable foundry in Midwest. Must be capable of layout work and have some experience in malleable work. Please state age, experience and salary expected in reply.

HW569—Foundry Superintendent: for shop producing 500 tons carbon and alloy steel, 300 tons electric iron and 150 tons brass pressure vessel castings per month. Must have broad and extensive experience in foundry operations, proven administrative ability and good practical and technical background. Excellent opportunity with long-established company of best reputation. Reply in confidence giving full information as to age, background and experience as well as salary requirements.

HW570 — Research Metallurgist: thorough training in physical metallurgy and the structure of metals. Recent graduate acceptable. Advanced degree desirable. Field includes metallography, radiography, welding, elevated temperature evaluation, alloy development, foundry process studies, etc. Well established firm expanding under aggressive management.

HW571—Foundry control Metallurgist: engineering education desirable. Assistant in staff group engaged in testing and control of foundry alloys, sands, etc., and "trouble shooting." Firm operates both ferrous and non-ferrous foundries. Well recognized in its field, under progressive management. Offers opportunity for advancement for competent man.

HW572—Maintenance Superintendent: for semi-mechanized Midwest foundry now producing 2500 tons of castings per month. Must have experience in electrical and mechanical foundry maintenance. Must be capable of planning and directing preventive maintenance program as well as normal repairs and break-downs. Must have record of good labor relations. Excellent opportunity, good salary and bonus for right man. Send resume of work history and names of references.

HW573—Foundryman: One of the nation's leading research organizations urgently needs an experienced, top-level foundryman for consulting work with small foundries in India. He must know entire operation of small foundries—sand, molding, melting, labor training, and management. One year assignment; carries excellent salary plus all expenses. He will work as part of a high-level research team.

POSITIONS WANTED

PW160—Metallurgist. B. S. in Met. Eng. Two years' experience covering acid electric steel and gray iron control; sand, metallurgical and chemical laboratory supervision. Desires responsible position with a future.

PW162—Metallurgist: varied practical experience as assistant foundry metallurgist in a captive foundry, automotive, and as superintendent of jobbing shop making ductile iron, semi-steel, brake shoes, railroad, Ni Resist castings in synthetic and natural bonded green and dry sand. Extensive cupola experience and progressive sand control. Cost-conscious Minnesota or Wisconsin foundry preferred.

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7	Cupola Operations Handbook	6.00	10.00
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